

# DOWNLOAD PDF PRESSURE-SENSITIVE ADHESIVES FOR ELECTRO-OPTICAL APPLICATIONS DANIEL L. HOLGUIN AND E.P. CHANG

## Chapter 1 : Full text of "USPTO Patents Application "

*Presenting the end-use and application technologies of pressure-sensitive adhesives and products, Volume three of the "Handbook of Pressure-Sensitive Adhesives and Products" discusses the build up and classes of pressure-sensitive products, the main representatives of pressure-sensitive products, and their application domains.*

Bevier Engineering Library provides access to books and journals both in print and electronically, in addition to a wide variety of databases to serve the teaching and research needs of following disciplines: The Library is named in honor of George M. Specifically, University Library System also provides access to many remote resources for the University of Pittsburgh faculty, students, and staff, including Compendex, Web of Science, ScienceDirect, Knovel and thousands of electronic journals from publishers, including the American Chemical Society, the Institute of Physics, Elsevier and Wiley. The concept of centers and institutes within the University and the Swanson School of Engineering takes advantage of this natural grouping process, thereby producing synergistic interactions that enhance the faculty research capabilities. Consequently, the scope of research that can be addressed by any group of faculty is expanded significantly. The students who participate in center and institute research have a unique opportunity to be involved in important projects throughout their graduate experience. Furthermore, centers and institutes represent an attractive opportunity for corporate and agency sponsorship of both basic and applied research. There are a number of centers and institutes that exist in the University and the Swanson School of Engineering and several that are in various developmental stages. The following are brief descriptions of existing centers and institutes. Benedum Hall of Engineering. The building complex is named in honor of Michael L. Benedum, a pioneer in the oil industry and co-founder of the Benedum Trees Oil Company. A grant from the Claude Worthington Benedum Foundation enabled the University to purchase the land on which the engineering complex is built. Benedum Hall of Engineering consists of a completely air-conditioned floor engineering tower and a separate seat auditorium. Classrooms and offices occupy the perimeter of the building, with the library, student lounge and student activities offices located on the plaza level. Laboratories are confined to central bays with heavy-equipment laboratories located in the sub-basement, which extends under the entire complex. These large rooms accommodate special instructional facilities that approximate actual industrial conditions. Over corporations, including a number of emerging high-technology companies, have offices at U-PARC. BST3, one of the most advanced research facilities of its kind, houses more than 50 laboratories occupied by approximately scientists, graduate students, technicians, and support staff. Among the programs housed in BST3 are: The story structure was built to stand as a national model for how modern laboratory space should promote interaction among scientists, foster more fruitful collaborations, and adapt to ever-changing research demands and priorities. Bioengineering research at BST3 includes applications of microtechnologies to explore cell polarity during vertebrate cell differentiation, cell and tissue mechanics during vertebrate development, biomaterials for neural prostheses and tissue regeneration, and unraveling how neural circuits transform sensory inputs into motor commands. Center for Assistive Technologies The Center for Assistive Technologies in the School of Health and Rehabilitation Sciences is comprised of rehabilitation engineers, physical and occupational therapists, and technicians who closely collaborate with a regional and national network of physicians, vocational counselors, educators, physical and occupational therapists, speech and language pathologists, rehabilitation technicians, consumers, and advocates in the provision of assistive technological services. Its mission includes the encouragement of the development of cross-disciplinary research teams by providing laboratory space and interdisciplinary educational programs. The Center site is located one mile from the main University of Pittsburgh campus. The Department of Bioengineering occupies about 12, sq. The following bioengineering laboratories are currently housed at the Center: These areas of research focus, coupled with associated educational initiatives and

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regional industrial collaborations, make the Center for Energy unique among other university energy centers in the USA. As a University-wide endeavor, the Center for Energy leverages the energy-related expertise of more than 40 faculty members from multiple disciplines, including chemical engineering, chemistry, civil engineering, electrical engineering, industrial engineering, geology, mechanical engineering, and materials science. A major goal and defining characteristic of the Center is to work closely with the concentration of energy-related companies in this region and from around the globe. To that end, the Center acts as an easily accessible entry point for industry in identifying energy-related research expertise, form collaborations, and participate in research at the University. SAM is dedicated to supporting and facilitating computational-based research across campus. Faculty across the University are using modeling and simulation to further their research. SAM serves as a catalyst for multidisciplinary collaborations among professors, sponsors modeling-focused seminars, teaches graduate-level modeling courses, and provides individual consultation in modeling to all researchers at the University. Jordan Chem are co-directors of SAM. There are more than 50 faculty associated with SAM using simulation and modeling at the University. They come from a wide range of disciplines, including astronomy, biology, chemistry, economics, engineering, health, and medicine. Areas of research include: Computational resources are available through SAM, which has a full-time technical director who assists users with installation and parallelization of software. SAM provides in house high-performance computing HPC resources allocated for shared use for campus researchers. The cluster compute nodes were purchased with funds provided by the University and by faculty researchers. The Institute mission includes the development of innovative clinical protocols as well as the pursuit of rapid commercial transfer of its technologies related to regenerative medicine. Regenerative medicine is an emerging field that approaches the repair or replacement of tissues and organs by incorporating the use of cells, genes, or other biological building blocks along with bioengineered materials and technologies. Graduate and undergraduate students conduct research toward their degrees in the Department of Bioengineering or any of the traditional engineering disciplines. The MSRC encourages collaboration between clinical and basic scientists in the study of the musculoskeletal system. Education is the primary goal of the MSRC. Students work with bioengineers, orthopaedic surgeons, biochemists, molecular biologists, and gene therapists, exploring innovative orthopaedic applications of basic science principles and technologies. Richard Debski and Dr. Current research activities include the analysis and modeling of human postural control; design of vibrotactile feedback for balance; pulse propagation in dispersive media; and propagation-invariant classification of underwater sounds. The installation includes three units for field ion microscopy and atom probe analysis. This state-of-the-art laboratory is the most comprehensive and complete NSF funded laboratory of its kind in the United States and focus on information systems engineering and software development. The facility is designed to aid the teaching of Automatic Data Capture concepts and tools to undergraduate and graduate engineering students. Students gain hands-on skills and perform research in such technologies as virtual enterprises, bar codes, wireless communications, speech recognition, and smart cards. They are involved in projects in areas including E-Commerce and web software development, automatic data collection for new product conformance testing, and supply chain engineering. These labs are collocated as they make use of much of the same equipment even though their research domains are distinct. Equipment includes barcode technology, magnetic stripe, RF Data Capture, machine vision and voice technology. All software operates on ten networked Pentium Computers. Some of the application software includes manufacturing execution and warehouse management, inventory management, vision and voice inspection, personnel access, barcode printing, barcode verification, magnetic strip encoding and decoding, and point of sale POS Control. The Institute develops and implements the latest product and processing technology for producers, fabricators, and end-users. Bioengineering Design and Multimedia Laboratory The Design and Multimedia Laboratory facilitates the interaction of small interdisciplinary student teams in an effort to collaboratively solve

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real-world design, analysis, and 22 prototyping problems. The lab is outfitted with a network cluster of 19 custom built PCs and peripherals all with comprehensive design capabilities, enabling students to develop paperless designs that have been analytically dissected and evaluated. In addition, students have access to an square foot multimedia area where professional level presentations and technical demonstrations are developed, rehearsed, and delivered. Bioengineering Instrumentation and Physiology Laboratory This laboratory was designed to accommodate small teams of students working collaboratively and is unique in that it enables students to obtain instruction in a lecture environment and directly apply that information in a hands-on laboratory setting. Students can experience experimental data collection, data processing and data analysis all in one facility. The laboratory is equipped with sixteen experimental stations. Each station can accommodate three students and is equipped cluster of 16 custom built PCs and peripherals. All computers are running Windows 7 as the operating system. The Biopac adapter provides the students with the ability to collect physiological measures and analyze the signals through several different isolated plug-in signal conditioners and amplifiers. Bioengineering Methods and Applications Laboratory The facility enables students to participate in an undergraduate laboratory course that integrates the knowledge and skills from three core Bioengineering courses including: The laboratory is designed to accommodate 24 students in a session. Bioengineering Tissue Engineering Laboratory This facility is adjacent to the Methods and Applications Laboratory described above and provides state-of-the-art tissue engineering facilities for graduate students. Equipment in the laboratory includes a biological flow hood, incubator, centrifuge, microscopy station, and several freezers. The facility utilizes a variety of motion analysis systems, force-plate equipment and EMG units to collect kinematics, kinetics and muscle activity during various human movement experiments. An overhead support system allows for the safe collection of data during locomotion on flat and inclined surfaces. Modeling software is also available to simulate, validate and predict whole-body biomechanics. We use tools from chemistry, biology, and materials science and engineering to create functional biomaterials that enable new treatments in regenerative medicine. We actively engage in 3 areas of research: Project 1 introduces coacervate, nm-sized oil droplet of assorted organic molecules held together by hydrophobic forces from a surrounding liquid, to controlled release of proteins. This novel approach enables highly efficacious delivery in a very small package. Project 2 uses biodegradable elastomeric scaffolds to enable in-situ regeneration of small diameter arteries without cell seeding or culturing steps. Project 3 combines micron scale contact guidance with biomimetic presentation of growth factors. The end goal of all 3 projects is clinical translation and we are actively collaborating with clinicians, basic scientists, and engineers to pursue this. Youngjae Chun and its objective is to design, manufacture, and test medical devices for treating vascular diseases. Primary research focuses on improving device performance and developing more diverse biomedical applications for treating vascular diseases with a focus on novel materials and manufacturing concepts. Facilities include in-vitro pulsatile flow circuits with vascular disease models, cell-tissue culture capabilities, and florescent microscopy with imaging system. Current research is focused on the development of a novel in-vitro test apparatus for characterizing flow alterations and monitoring local blood pressure distributions with the placement of endovascular devices. Biomedical Materials Laboratory This laboratory, under the direction of Yadong Wang, PhD, works at the interface of chemistry, materials, and medicine. The research focus is on creating biomaterials that present controlled chemical, physical, and mechanical signals to the biological systems. The ultimate goal is to direct how human bodies will interact with these materials in a therapeutic environment. The laboratory actively engages in collaborative efforts to explore the applications of these materials in cardiovascular tissue engineering, nerve regeneration, and controlled release of therapeutics. The major equipment of the laboratory includes essential tools for chemical synthesis inert atmosphere box, GPC, microwave synthesis station and cell biology plate reader, microscope, RT PCR. Much of the work in this laboratory focuses on understanding and quantifying the link between material behavior and structure.

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These results are used for the development of constitutive equations to model these materials in a predictive fashion. A second focus of the laboratory is the study of the motion and stability of particles in viscous and viscoelastic fluids. Major equipment includes a Sun workstation for finite element analysis fluid dynamics, spectrophotometers for colorimetric composition analysis, plate reader for colorimetric composition analysis, blood-gas analyzer, table-top refrigerated centrifuge, cell incubators, and Prisma dialysis machines. Other equipment includes multiple roller pumps, gas mass flow controllers, oscilloscope, electrochemistry controllers and analyzers. Cardiovascular Systems Laboratory This laboratory is under the direction of Sanjeev Shroff, PhD and focuses on research related to cardiovascular mechano-energetics and structure-function relationships. This research utilizes a variety of biophysical, cell and molecular biology, biochemistry, and imaging techniques. Cell and Molecular Biophysics Laboratory This research laboratory is under the direction of Hai Lin, PhD and offers graduate and undergraduate students the ability to participate in research related to Cellular and Molecular Biophysics.

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## Chapter 2 : APS APS March Meeting - Session Index MAR06

*Construction and classes and main pressure-sensitive products / István Benedek --Electrically conductive adhesives in medical applications / J. Anand Subramony --Pressure-sensitive adhesives for electro-optical applications / Daniel L. Holguin and E.-P. Chang --End-use domains and application technology of pressure-sensitive adhesives and.*

They can be considered laminates. In principle, laminate constructions are not new. They were developed in the packaging material industry. This was possible partially because of the development of laminated face stock materials. Such multiweb constructions have been produced by bonding the solid-state components through adhesive coating or by extrusion. Theoretically, the common adhesive-coated laminates are. Generally, in the construction of PSPs, such permanent laminates can be built up in a temporary laminate. Permanent laminates serve as carrier materials; temporary laminates are PSPs. Some PSPs, e. Principally, there are sheet laminates and roll laminates. Because of the balanced adhesive performance characteristics. The liner allows labels to be processed. The liner makes the web like a application of sheet-like. Almost all label stocks and double-side pressure-sensitive tapes use a separate release web. Such products with temporary multiple solid-state components are laminates see also Technology of Pressure-Sensitive Adhesives and Products, Chapter For instance, certain tapes must be primed to ensure good anchorage of the adhesive on the carrier see also Technology of Pressure-Sensitive Adhesives and Products, Chapter For some tapes a release layer should be coated on the back side of the carrier. Such tapes include double-side products and transfer tapes, which need a separate solid-state release or carrier layer. In this way, various multilayer products are manufactured with multilayers of soft components. Pressure-sensitive laminates manufactured to protect the adhesive-coated surface of a tape or label are an example of temporary construction. In such products the release liner may protect the adhesive or other components incorporated in the adhesive layer see also Chapter 4. Another role of the separate release liner is that of a continuum passing through the coating, converting, and labeling machines carrying the discontinuous label. Decals or labels applied by hand do not need this function. In some cases, such as the manufacture of transfer tapes, the use of a solid-state component is a technological modality used only to build up and apply the product. A patent [5] describes the use of ultraviolet [UV]-light-induced photopolymerization of acrylic monomers directly on the carrier to manufacture tape. The tapes have PSA on both sides of the carrier. Labels and certain tapes are built up during manufacturing and application as temporary laminates and are used as permanent laminates. Multiweb constructions can include solid-state components and adhesives that differ in their chemical nature and build-up. For instance, double-side-coated tapes can have a PSA on one side and a reaction mixture of uncross-linked polyurethane PU on the other side. A polyvinyl chloride PVC tape applied on a PU foam reacts with the adherent and adheres to it chemically. Double-side mounting tapes may have different adhesives on each side of the carrier see also Chapter 4. Labels may also have a very complex construction. For instance, label construction may contain seven layers as follows: Such multilayer self-adhesive labels comprise a carrier label containing silicones, an adhesive layer, a printed message, a carrier layer. Labels may have more than two adhesive-carrier layer-message layer units. Labels are variances of such construction. Double-side-coated tapes are used with or without a carrier. The adhesive characteristics as well as the chemistry of the adhesive layers may be quite different. Common industrial practice uses multilayer adhesives constructed from a rigid primer and soft adhesive to control energy dissipation, that is, removability see also Technology of Pressure-Sensitive Adhesives and Products, Chapter 1. In other cases, the product itself has a sophisticated multilayer structure including various solid-state components. Such products are constructed composites see also Technology of Pressure-Sensitive Adhesives and Products, Chapter 1. They can also include soft components with a composite structure. The release liner itself may also have a m

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multilayer construction. For instance, different degrees of release are achieved for a double-side liner and a release paper, coated on one side with PE and using the same release component. Continuous or discontinuous carrier materials as well as adhesive layers with a special geometry and multilayer composite build-up can be used. A porous carrier may be required as well. The carrier can also have an asymmetric construction geometry, surface quality, etc. A patterned PSA transfer tape may possess an asymmetric carrier material, which has one surface with a series of recesses and another that is smooth. In some cases the cross-section of the carrier differs from a usual parallelepiped. Masking tapes can have special carrier constructions to allow conformability. For instance, a masking tape carrier can have a stiffened, wedge-shape, adhesiveless, longitudinal section the thickest away from the tape centerline extending from one edge, with a pleated structure to conform to small radii. A packaging tape can have a central tear section. The central tearaway portion is built up with two parallel lines of perforations extending the entire length of the flexible part. Adhesive tapes with the adhesive-coated area narrower than the substrate and one edge with an adhesive-free strip have an easy-untilt property and are useful for bundling electronic parts, building materials, vegetables, and other items. As described in detail in Refs. Filling reduces the costs and ensures special properties such as improved cohesion and converting properties and control of thermal or electrical conductivity see also Chapter 4. Filled medical PSAs were described in Ref. Pressure-sensitive hydrogels are a special domain of bioadhesives that contain water, as described by Feldstein et al. Filled hydrocolloids were discussed by Kulichikhin et al. Filled adhesives play an important role in the manufacture of carrierless PSPs as well see Section 1. Coating of the adhesive as a noncontinuous layer with discrete areas allows control of the bonding&quot;debonding properties [14]. Producers are looking to manufacture their own base label stock or special stripe-, patch-, or spot-coated adhesive construction and labels with adhesive-free zones. The tape can be manufactured with less adhesive than conventional tapes and its top side can be printed and perforated. Adhesive tapes with a narrower adhesive-coated width than that of the substrate and one edge with an adhesive-free strip have easy-untilt properties and are useful for bundling electronic parts, building materials, vegetables, and other commodities. The adhesive layer can have a rough surface as well, with channels to enclose air flow between the adherent and the sheet. An adhesive tape may have adhesive only a long the lengthwise edges to allow easy perforation [16]. A removable display poster is manufactured by coating distinct adhesive and nonadhesive strips on the carrier. The adhesive strips are situated on the same plane, with the plane elevated with respect to the product surface. Multilayer adhesive construction can also be manufactured. Here the PSA-coated carrier material functions as a transfer base for a heat-activatable adhesive. After application of the heat-sensitive adhesive, the PSA-coated tape can be peeled off [17]. PSPs that are built up, such as an uncoated monoweb, are composed of a carrier material only. This carrier must have a special chemical nature or undergo special physical treatment to allow self-adhesion under special application conditions pressure, temperature, and previous surface treatment. The development of macromolecular chemistry and extrusion technology allows the manufacture of carrier materials with built-in pressure sensitivity, that is, PSPs constructed like an uncoated monoweb but behaving, when applied, like a coated web. Carrier materials with adhesivity were discussed in detail in Refs. Uncoated monoweb used as PSPs can have a homogeneous or heterogeneous structure. The whole carrier can be autoadhesive. The manufacture of a self-supporting adhesive material is a complex procedure. The adhesive bond is the result of chemical attraction as well as physical anchorage. Both require contact surface and interpenetration, that is, flow. Unfortunately, mechanically resistant, self-supporting products exhibit only a limited flow, with the exception of PVC, which is due to its plasticizing ability an ideal material to achieve self-adhesive performance without loss of mechanical strength. Depending on its formulation and softness, PVC can be used as a self-adhesive medical tape carrier or as an adhesive for such products. For instance, decorative decals. Such monoweb tapes are mostly special or experimental products. In practice, the manufacture

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of an uncoated, self-adhesive adhesive material is a complex procedure, described in Ref. It is the most important solidstate part of the product, functioning as a packaging-, protecting-, and information-carrying component. This is a common role of the carrier material in labels, tapes, and protective webs, and only a few web-like PSPs do not have a solid-state face stock material. For some of these products. However, because of its discontinuity and to ensure the required mechanical resistance during manufacture and application, such PSPs also require a release liner. Transfer-printing materials like Letraset can be considered carrierless or temporary laminates with a monoweb character after application. The design and formulation of carrierless products was discussed by Benedek in Ref. Various technical possibilities for manufacturing a self-sustaining, carrierless, self-adhesive product exist. Principally, the carrier can be softened or the adhesive can be reinforced. Strengthening/stiffening of the macromolecular structure of the adhesive is possible using several methods. Coating is used to manufacture the web-like self-supporting adhesive, which can be postfoamed and postcured. The chemical basis and some manufacturing methods for carrierless tapes are summarized by Benedek in Ref. Sheet-like hot melts are used for thermal lamination of various web-like materials. For such applications, EVA and ethylene-propylene copolymers, copolyesters, copolyamides, vinyl chloride copolymers, and thermoplastic PURs have been developed. Special tapes exist that have an adhesive with a carrier-like character.

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## Chapter 3 : SSOE Statistical Summary by PITT | SWANSON School of Engineering - Issuu

*Currently for applications where there is a pressure sensitive adhesive bond components of the light transmitting devices; lens (or lenses), or other components (i.e. light management films), the adhesive is acrylic with a refractive index of*

What is claimed is: An adhesive article comprising: The adhesive article of claim 1 further comprising a release liner releasably adhered to the lower surface of said radiation curable adhesive layer. The adhesive article of claim 1 wherein said acrylic pressure sensitive adhesive comprises an acrylic copolymer of glycidyl acrylate monomer. The adhesive article of claim 1 wherein said acrylic pressure sensitive adhesive comprises, a monomer selected from the group consisting of alkyl acrylate esters and alkyl methacrylate esters containing from 4 to about 12 carbon atoms in the alkyl group; and a glycidyl acrylate monomer. The adhesive article of claim 1 wherein said acrylated urethane oligomer comprises the reaction product of an acrylate ester containing an active hydrogen atom in the alcoholic moiety of the ester and an organic polyisocyanate. The adhesive article of claim 1 wherein said adhesive layer further comprises a photoinitiator. The adhesive article of claim 1 further comprising a radiation curable epoxy layer between said radiation curable adhesive layer and said transparent carrier layer. The adhesive article of claim 7 wherein said radiation curable epoxy layer comprises at least one epoxy resin selected from the group consisting of bisphenol A epichlorohydrin epoxy resin, bisphenol A epoxy diacrylate, and mixtures thereof. The adhesive article of claim 8 wherein the radiation curable epoxy layer further comprises a photoinitiator. The adhesive article of claim 8 wherein the radiation curable epoxy layer further comprises an amine curing agent. The adhesive article of claim 12 further comprising a release liner releasably adhered to the lower surface of said radiation curable adhesive layer. The adhesive article of claim 12 wherein the radiation curable adhesive layer further comprises an acrylated urethane oligomer comprising the reaction product of an acrylate ester containing an active hydrogen atom in the alcoholic moiety of the ester and an organic polyisocyanate. The adhesive article of claim 12 wherein said radiation curable adhesive layer further comprises a photoinitiator. The adhesive article of claim 12 wherein said radiation curable adhesive layer further comprises a silane coupling agent. The adhesive article of claim 12 further comprising a radiation curable epoxy layer between said adhesive layer and said transparent carrier layer. The adhesive article of claim 17 wherein said radiation curable epoxy layer comprises at least one epoxy resin selected from the group consisting of bisphenol A epichlorohydrin epoxy resin, bisphenol A epoxy diacrylate, and mixtures thereof. The adhesive article of claim 18 wherein the radiation curable epoxy layer further comprises a photoinitiator. The adhesive article of claim 18 wherein the radiation curable epoxy layer further comprises an amine curing agent. An adhesive article comprising a. The adhesive article of claim 22 wherein said radiation curable epoxy layer comprises at least one epoxy resin selected from the group consisting of bisphenol A epichlorohydrin epoxy resin, bisphenol A epoxy diacrylate, and mixtures thereof. The adhesive article of claim 22 wherein the radiation curable epoxy layer further comprises a photoinitiator. The adhesive article of claim 22 wherein the radiation curable epoxy layer further comprises an amine curing agent. The adhesive article of claim 26 wherein said radiation curable epoxy layer comprises at least one epoxy resin selected from the group consisting of bisphenol A epichlorohydrin epoxy resin, bisphenol A epoxy diacrylate, and mixtures thereof. The adhesive article of claim 26 wherein the radiation curable epoxy layer further comprises a photoinitiator. The adhesive article of claim 26 wherein the radiation curable epoxy layer further comprises an amine curing agent. The adhesive article of claim 1 wherein the transparent carrier layer is polymeric. They generally have a structure comprising: The structure of the color filter is arranged so that a colored layer of a black matrix and a plurality of colors generally three primary colors, red R , green G and blue B is provided on a transparent substrate and a protective layer and a transparent electrode are stacked

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thereon in that order. These color liquid-crystal displays are constructed so that a color image is obtained by controlling the light transmission of the liquid-crystal layer in its portions corresponding to pixels of respective colored layers R, G and B. In the color filter, the protective layer functions to protect and flatten the colored layer. In general, color liquid-crystal displays have a problem that the presence of an uneven gap attributable to the waviness of the surface of the transparent substrate in the color filter, an uneven gap among R, G and B pixels, or an uneven gap within pixels of R, G and B lowers the flatness of the transparent electrode. This causes uneven colors and uneven contrast, leading to lowered image quality. In particular, in color liquid crystal displays of super-twisted nematic STN system, the flatness greatly affects the image quality. This renders flattening by the protective layer very important. In use, the color filter is adhered to the counter electrode. The assembly is then tested for display quality. In consideration of the reusability of the color filter when the assembly is judged to be unacceptable in the display quality test, the protective layer is preferably provided only in specific regions so as to cover the colored layers on the transparent substrate. To this end, the protective layer has been formed using a photocurable resin that permits portions to be cured to be easily limited through a mask. In the formation of the protective layer using the conventional resin, an organic solvent has been used in the development after exposure of the radiation curable protective coating material to UV radiation. This is troublesome in handleability and wastewater treatment and further lacks in profitability and stability. European Patent Application Publication No. A photocurable resin is described which, by virtue of the introduction of an acidic group into the photocurable resin, permits alkali development after exposure. The photocurable resin composition comprises: The adhesive article is useful in forming a protective coating on a color filter. The adhesive article may be a tape or a label and may also include a curable epoxy layer between the curable pressure sensitive adhesive layer and the transparent carrier film. In another embodiment, a radiation curable pressure sensitive adhesive layer is a removable adhesive that may be used to position a radiation curable epoxy layer on a color filter. The radiation curable epoxy layer and radiation curable pressure sensitive adhesive are exposed to radiation through a mask positioned over the colored layers of the color filter. The radiation exposure transforms the pressure sensitive adhesive from a removable adhesive to a permanent adhesive. The uncured epoxy layer portions and the uncured adhesive portions are removed with the removal of the carrier film. The remaining multilayer structure is then baked to fully cure the epoxy layer and to transform the adhesive further into a near structural adhesive. In one embodiment, the fully cured epoxy and adhesive layers together make up the protective coating for the color filter. In another embodiment, the fully cured adhesive layer itself makes up the protective coating for the color filter. The adhesive article of the present invention comprises: The adhesive article of the present invention may also comprise: The method of manufacturing the protective coating on a color film of the present invention comprises the steps of: The method of manufacturing the protective coating of the present invention may also comprise the steps of: The adhesive article comprises a pressure sensitive adhesive layer and a transparent carrier film overlying the adhesive layer. The adhesive article may also include a thin layer of epoxy coated onto a transparent carrier film and overlying the pressure sensitive adhesive layer. After affixing the pressure sensitive adhesive side of the adhesive article to the surface of the color filter, portions of the adhesive article are exposed to UV radiation. The transparent carrier film is then removed, leaving the cured epoxy layer, if present, and cured pressure sensitive adhesive portions on the surface of the color filter. The uncured epoxy portions and pressure sensitive adhesive portions are removed with the transparent carrier film. The structure consisting of the cured epoxy layer, pressure sensitive layer, color filter and transparent substrate is then baked to cure the epoxy layer and adhesive layer. Pressure sensitive adhesives useful in one embodiment of the present invention should have adequate adhesion to the epoxy layer throughout the manufacturing process. The uncured pressure sensitive adhesive should be easily removable from the transparent substrate on which the color filter is formed. The cured pressure sensitive adhesive should adhere

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to the color filter and adhere to the epoxy layer so that the cured epoxy layer may be removed from the carrier film. The baked pressure sensitive adhesive should anchor the baked epoxy layer to the color filter and should transmit light. The protective coating is optically transparent. The pressure sensitive adhesive of the present invention transforms upon UV radiation exposure from a removable adhesive to a permanent adhesive, and upon heat treatment to a near structural adhesive to support the steps of the process of making a protective coating for the color filter. The pressure sensitive adhesive contains at least one acrylic copolymer and may contain at least one photoinitiator. The pressure sensitive adhesive may also contain at least one acrylated urethane oligomer, and may also contain a silane coupling agent to improve adhesion. Useful acrylic copolymers include high performance pressure sensitive adhesives, which contain a glycidyl acrylate monomer. The alkyl acrylate and methacrylate esters containing 4 to about 12 carbon atoms in the alkyl group useful in forming the acrylic copolymers include 2-ethyl hexyl acrylate, isooctyl acrylate, butyl acrylate, sec-butyl acrylate, methyl butyl acrylate, 4-methylpentyl acrylate, isodecyl methacrylate and the like, and mixtures thereof. The glycidyl acrylate monomers useful in forming the acrylic copolymers include glycidyl acrylate and glycidyl methacrylate and mixtures thereof. The N-vinyl lactam monomers that may be used include N-vinyl pyrrolidone, N-vinyl caprolactam, 1-vinylpipericone, 1-vinylmethylpyrrolidone and the like. Ethylenically unsaturated carboxylic acids include acrylic acid, methacrylic acid, fumaric acid and the like. Alkyl acrylate and methacrylate esters containing less than 4 carbon atoms in the alkyl group include methyl acrylate, ethyl acrylate, methyl methacrylate and the like. Other monomers that can be included are polystyryl ethyl methacrylate, acetoacetoxy ethyl methacrylate, alpha olefins such as ethylene and propylene and vinyl esters of alkanolic acids containing more than three carbon atoms as well as mixtures thereof. Such monomers are in the range of from 0 to about 35 percent by weight of the total monomers. The copolymers may be synthesized using solution, emulsion, and batch polymerization techniques. It is preferred to prepare the copolymers in solution using a mixture of solvents. The present preferred solution polymerization involves the use of blends of ethyl acetate and hexane or ethyl acetate and acetone. The polymers formed are solvent soluble polymers with essentially no crosslinking. Polymers can be post-polymerization cross-linked using radiation. Such acrylic copolymers are described in U. Useful acrylated urethane oligomers include acrylate esters that are formed by the reaction of a an acrylate ester containing an active hydrogen atom in the alcoholic moiety of the ester, with b an organic polyisocyanate. Compositions including this general type of ester are disclosed in U. In one embodiment, the active hydrogen is the hydrogen of a hydroxyl or a primary or secondary amine substituent on the alcoholic moiety of the ester, and the polyisocyanate is a diisocyanate. An excess of the acrylate ester should be used to ensure that each isocyanate functional group in the polyisocyanate is substituted. The acrylate esters used in the manner described in the preceding paragraph may be those in which the acrylate ester is a substituted alkyl or aryl acrylate ester. Such acrylate esters include those having the formula: R<sup>2</sup> and R<sup>3</sup> can contain any substituents or linkages that do not adversely affect the molecule for its intended use herein. Such acrylated urethane oligomers are described in U. Examples of suitable acrylated urethane oligomers include aliphatic polyether urethane acrylates, diacrylates and polyacrylates; aliphatic polyester urethane acrylates, diacrylates and polyacrylates, aromatic polyether urethane acrylates, diacrylates and polyacrylates; and aromatic polyester urethane acrylates, diacrylates and polyacrylates. Useful photo initiators include acetophenone, benzophenone, benzoyldimethylketal, benzoyl peroxide, isobutyl benzoin ether, isopropyl thioxanthone, diethoxy acetophenone and 2-chlorothioxanthone. A particularly useful photoinitiator is benzophenone. Silane coupling agents useful herein include vinylsilane, acrylsilane, epoxysilane and aminosilane. Epoxy resins useful for making the epoxy layer of the present invention include epoxy resins and polymeric epoxy resins. These resins can vary greatly in the nature of their backbones and substituent groups. The epoxy resins of the invention can undergo initial curing upon exposure to UV radiation via a free radical mechanism with the addition of an appropriate photoinitiator.

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## Chapter 4 : Protective coating for color filters - Avery Dennison Corporation

*Applications Daniel L. Holguin and E.-P. Chang Applications of Pressure-Sensitive Adhesives and Two main types of PSAs for electro-optical applications are.*

The present application is also a continuation of U. A method for the preparation of a powdered poly 2-hydroxyethyl methacrylate comprising: The method of claim 1, wherein the monomeric 2-hydroxyethyl methacrylate contains ethylene glycol dimethacrylate impurities in the range of about 0. The method of claim 1, comprising introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities of at least 0. The method of claim 1, further comprising blending the powder with a polyalkylene glycol to prepare a hydrophilic pressure sensitive adhesive. The method of claim 5, wherein the polyalkylene glycol is selected from the group consisting of polyethylene glycol, polypropylene glycol and copolymers of ethylene glycol and propylene glycol, and mixtures thereof. The method of claim 5, wherein the ratio of powder to polyalkylene glycol in is the range of about 1: The method of claim 2, comprising introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. The method of claim 2, further comprising blending the powder with a polyalkylene glycol to prepare a hydrophilic pressure sensitive adhesive. The method of claim 10, wherein the polyalkylene glycol is selected from the group consisting of polyethylene glycol, polypropylene glycol and copolymers of ethylene glycol and propylene glycol, and mixtures thereof. The method of claim 10, wherein the ratio of powder to polyalkylene glycol in is the range of about 1: The method of claim 1, wherein the monomeric 2-hydroxyethyl methacrylate introduced into the water includes a blend of monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. The method of claim 13, comprising introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. The method of claim 13, further comprising blending the powder with a polyalkylene glycol to prepare a hydrophilic pressure sensitive adhesive. The method of claim 16, wherein the polyalkylene glycol is selected from the group consisting of polyethylene glycol, polypropylene glycol and copolymers of ethylene glycol and propylene glycol, and mixtures thereof. The method of claim 16, wherein the ratio of powder to polyalkylene glycol in is the range of about 1: A hydrophilic pressure sensitive adhesive prepared by the method of claim 5. A hydrophilic pressure sensitive adhesive prepared by the method of claim 1. A cosmetic composition or skin care composition containing the powder prepared by the method of claim 1. A cosmetic composition or skin care composition containing the powder prepared by the method of claim 2. A method of coating a substrate comprising applying the hydrophilic pressure sensitive adhesive prepared by the method of claim 5 to the substrate. A method of coating a substrate comprising applying the hydrophilic pressure sensitive adhesive prepared by the method of claim 10 to the substrate. A method of coating a substrate comprising applying the hydrophilic pressure sensitive adhesive prepared by the method of claim 16 to the substrate. In this family of synthetic hydrophilic polymers, poly 2-hydroxyethyl methacrylate and poly hydroxybutyl acrylate are water insoluble polymers prepared from a water soluble monomer. The other polymers require crosslinking to form a water insoluble polymer. The extensive use of 2-hydroxyethyl methacrylate polymers for contact lenses for the eyes illustrates the non irritating nature of the polymers. Other than commercial use in contact lenses, 2-hydroxyethyl methacrylate polymers have had limited commercial success, used at low percentages only, because of the nature of the monomer. Industrial grade 2-hydroxyethyl methacrylate monomer contains a small amount of crosslinker impurity which can cause gel formation during solvent polymerization. The 2-hydroxyethyl methacrylate monomer is water soluble and the 2-hydroxyethyl methacrylate polymer is water insoluble which causes difficulty in emulsion polymerization employing a high portion of 2-hydroxyethyl methacrylate monomer. The preparation of 2-hydroxyethyl

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methacrylate polymer therefore generally requires the use of very pure and expensive monomer, having ethylene glycol dimethacrylate impurities less than 0. Requirements of high quality inkjet coatings include clarity, water resistance, good ink absorption with quick drying, and low surface friction to enhance sheet feeding in inkjet printers. Typical inkjet coatings satisfy the requirements of water resistance, good ink absorption with quick drying, and low surface friction through the use of mixtures of polymers, or polymers with pigments, however, these mixtures are not clear. EP A1 describes the preparation of methanol soluble poly 2-hydroxyethyl methacrylate using high purity 2-hydroxyethyl methacrylate monomer. EP A1 describes acrylic graft copolymers and water soluble polymers. DE A1 describes water soluble copolymers with crosslinkers. In general, the present invention is directed to providing a cost-effective method for the preparation of hydrophilic 2-hydroxyethyl methacrylate homopolymers and copolymers with utility as films, coatings, pressure sensitive adhesives, and compositions suitable for topical application to the skin. The present invention is further directed to providing clear inkjet coatings without pigments that are water resistant and have good ink absorption with quick drying. The invention is also related to providing a cost-effective method for the preparation of gel-free, hydrophilic polymers, which have utility in topical skin applications, as cosmetic compositions, dermatological compositions, and as skin friendly coatings, as pressure sensitive adhesives, and as precursors for hydrogels. The alcohol is preferably selected from one of methanol and ethanol. Hydrophilic pressure sensitive adhesives are provided by adding polyethylene glycol to the polymerization mixture prior to removing the alcohol. Flexible hydrophilic coatings also are provided by adding glycerin to the polymerization mixture prior to removing the alcohol by drying. A method is also provided for the preparation of a gel free, hydrophilic, water soluble polymer substantially in the absence of a chain transfer agent comprising a copolymer of 2-hydroxyethyl methacrylate and acrylic acid or methacrylic acid, including introducing monomeric 2-hydroxyethyl methacrylate into water solution with one of acrylic acid and methacrylic acid, adjusting the pH of the solution to a pH in the range of greater than about pH 3 to less than about pH 9, and copolymerizing the monomeric 2-hydroxyethyl methacrylate and acrylic or methacrylic acid. In one embodiment, the monomeric 2-hydroxyethyl methacrylate contains at least 0. In another embodiment, the copolymer of 2-hydroxyethyl methacrylate and acrylic acid or methacrylic acid is blended with a polyalkylene glycol, such as polyethylene glycol, to form a pressure sensitive adhesive. In another embodiment, the copolymer of 2-hydroxyethyl methacrylate and acrylic acid or methacrylic acid is blended with glycerin to form a flexible coating. A method is also provided for the preparation of a gel free hydrophilic polymer substantially in the absence of a chain transfer agent comprising a copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate, including introducing monomeric 2-hydroxyethyl methacrylate containing no more than about 0. The alcohol is selected from one of methanol and ethanol, with ethanol being preferred. A method of preparing an acrylic emulsion ink jet receptive clear coating is also provided comprising: In another embodiment, the method further comprises subsequently reacting with said clear polymer in said alkyl acrylate monomer-containing pre-emulsion feed mixture, a water insoluble monomer feed mixture comprising 2-hydroxyethyl methacrylate, n-vinyl pyrrolidone, butyl acrylate, and methacrylic acid to form a clear polymer over said polymer in said alkyl acrylate monomer-containing pre-emulsion feed mixture. A method for the preparation of a powdered low gel poly 2-hydroxyethyl methacrylate substantially in the absence of a chain transfer agent is also provided comprising: In another embodiment, said poly 2-hydroxyethyl methacrylate powder is blended with a polyalkylene glycol, such as polyethylene glycol to form a pressure sensitive adhesive. A method is also provided for the preparation of a gel free hydrophilic copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 2-hydroxyethyl methacrylate containing no more than about 0. In a preferred embodiment, the alcohol is selected from one of methanol and ethanol, with ethanol being preferred. In another embodiment, the copolymer of 2-hydroxyethyl methacrylate

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and 4-hydroxybutyl acrylate is blended with a polyalkylene glycol, such as polyethylene glycol, to form a pressure sensitive adhesive. The invention also provides a method for the preparation of a gel-free homopolymer of 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 4-hydroxybutyl acrylate into alcohol, and polymerizing the 4-hydroxybutyl acrylate to form a polymerization mixture. In another embodiment, the present invention provides a method for the preparation of a gel free hydrophilic homopolymer of 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 4-hydroxybutyl acrylate into a solution of water and alcohol, and polymerizing the 4-hydroxybutyl acrylate. In another embodiment, the present invention provides a method for the preparation of a gel free hydrophilic homopolymer of 2-hydroxyethyl methacrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 2-hydroxyethyl methacrylate containing no more than about 0. These homopolymers of 2-hydroxyethyl methacrylate prepared are stable in solution. The present invention provides a method for the preparation of a water insoluble, gel-free copolymer of 2-hydroxyethyl methacrylate and acrylic acid or methacrylic acid substantially in the absence of a chain transfer agent comprising: In one embodiment, the monomeric 2-hydroxyethyl methacrylate useful in the inventive method may contain ethylene glycol dimethacrylate impurity in the range of about 0. Hydrophilic pressure sensitive adhesives are provided by adding polyalkylene glycol to the polymerization mixture. Flexible skin coatings are provided by adding a flexibilizing agent to the polymerization mixture. The present invention also provides a method for the preparation of a hydrophilic, gel-free, water insoluble copolymer of 2-hydroxyethyl methacrylate, 4-hydroxybutyl acrylate and at least one of acrylic acid or methacrylic acid substantially in the absence of a chain transfer agent comprising: In another embodiment, the monomeric 2-hydroxyethyl methacrylate useful in the inventive method contain ethylene glycol dimethacrylate impurity in the range of about 0. The present invention also provides a method for the preparation of a substantially monoalcohol-free, gel-free, water insoluble, hydrophilic copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising: In another embodiment, the monomeric 2-hydroxyethyl methacrylate that is useful in the inventive method may contain ethylene glycol dimethacrylate impurity in the range of about 0. Flexible skin coatings are provided by removing the water after the leaching and replacing steps. The invention further provides a method for the preparation of a substantially monoalcohol-free, gel-free, water insoluble, hydrophilic copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising: Flexible skin coatings are provided by substantially removing the water from the polymerization mixture. The invention further provides a method for the preparation of a substantially monoalcohol-free, gel-free, water insoluble, hydrophilic homopolymer of 2-hydroxyethyl methacrylate substantially in the absence of a chain transfer agent comprising: Flexible skin coatings are provided by substantially removing the water from the polymer after the leaching and replacing steps. The present invention further provides a method for the preparation of substantially gel-free, water insoluble, hydrophilic homopolymer of 2-hydroxyethyl methacrylate substantially in the absence of a chain transfer agent comprising: As such, this invention includes methods of preparing gel-free, hydrophilic, water insoluble homopolymers and copolymers, and gel-free, hydrophilic water soluble copolymers that are suitable in the formulation of topical compositions for application to human skin and hair, such as cosmetic compositions and dermatological compositions, and to their use as pressure sensitive adhesives and flexible coatings. Optionally, a thin film of the polymer product can be poured and visually inspected for particulates. The gel content is determined as follows: The edges of the filter are thermally sealed to contain the sample, and the filter is placed in a vial containing about 15 g of methanol. The filter is then weighed, and the resulting weight of the sample is used to calculate the percent gel as follows: The method includes introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of no more

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than about 0. Polymerization is induced by free radical initiation, and the alcohol is preferably removed by coating a substrate and drying the mixture. The controlled level of impurities results in the gel free polymer, even without using ultra-pure monomer. As described above, free radical polymerization is initiated by a suitable initiator. The initiator must be soluble in the alcohol and the 2-hydroxyethyl methacrylate monomer mixture. The method of the present invention, therefore, provides for the cost effective preparation of a gel-free poly 2-hydroxyethyl methacrylate, substantially in the absence of a chain transfer agent, using industrial grade 2-hydroxyethyl methacrylate monomer. A 2-Hydroxyethyl methacrylate monomer suitable for use in the method of the present invention is available from Mitsubishi Rayon, Japan. In another embodiment, the present invention provides a method for the preparation of a gel-free poly 2-hydroxyethyl methacrylate substantially in the absence of a chain transfer agent, to achieve a hydrophilic pressure sensitive adhesive. The method includes introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. Polymerization is induced by free radical initiation, and alcohol removal is preferably accomplished by coating the mixture onto a substrate and drying the mixture. Although the preferred polyalkylene glycol used to prepare the pressure sensitive is polyethylene glycol, other polyalkylene glycols, such as polypropylene glycol may be used. In addition, copolymers of ethylene and propylene glycol may also be used to form the pressure sensitive adhesive. The hydrophilic pressure sensitive adhesives formed by this method have utility in many label and tape applications, and is particularly suitable for medical applications. In yet another embodiment, the present invention provides a method for the preparation of a flexible hydrophilic coating comprising a gel-free poly 2-hydroxyethyl methacrylate produced substantially in the absence of a chain transfer agent. The method comprises introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. Polymerization is induced by free radical initiation, and alcohol removal by coating the mixture and drying. The flexible hydrophilic coating formed by this method has utility in skin-friendly applications in which a high Moisture Vapor Transmission Rate MVTR is needed together with protective, skin barrier properties. The coating is also suitable for printable coatings, such as inkjet coatings for paper, plastic film, and the like. While the above methods involve the formulation of a homopolymer of the 2-hydroxyethyl methacrylate monomer, the present invention also provides a method for the preparation of a gel free, hydrophilic, water soluble polymer comprising a copolymer of 2-hydroxyethyl methacrylate and acrylic acid or methacrylic acid. Copolymerization is induced by free radical initiation. A pH of 3 or less and a pH of 9 or greater should be avoided, because the reactants may precipitate out or not form a useable copolymer. In one embodiment, the 2-hydroxyethyl methacrylate monomer contains at least 0.

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The present invention also provides a method for the preparation of gel-free homopolymer of 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent in an alcohol or in solution of alcohol and water. The present invention also provides a method for the preparation of gel-free copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent, comprising introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. In this family of synthetic hydrophilic polymers, poly 2-hydroxyethyl methacrylate and poly hydroxybutyl acrylate are water insoluble polymers prepared from a water soluble monomer. The other polymers require crosslinking to form a water insoluble polymer. The extensive use of 2-hydroxyethyl methacrylate polymers for contact lenses for the eyes illustrates the non irritating nature of the polymers. Other than commercial use in contact lenses, 2-hydroxyethyl methacrylate polymers have had limited commercial success, used at low percentages only, because of the nature of the monomer. Industrial grade 2-hydroxyethyl methacrylate monomer contains a small amount of crosslinker impurity which can cause gel formation during solvent polymerization. The preparation of 2-hydroxyethyl methacrylate polymer, therefore, generally requires the use of very pure and expensive monomer or a very extensive and expensive polymerization process. EP A1 describes the preparation of methanol soluble poly 2-hydroxyethyl methacrylate using high purity 2-hydroxyethyl methacrylate monomer. EP A1 describes acrylic graft copolymers and water soluble polymers. DE A1 describes water soluble copolymers with crosslinkers. In general, the present invention is directed to providing a cost-effective method for the preparation of hydrophilic homopolymers and copolymers with utility as films, coatings, pressure sensitive adhesives, and compositions suitable for topical application to the skin. The alcohol is preferably selected from one of methanol and ethanol. Hydrophilic pressure sensitive adhesives are provided by adding polyethylene glycol to the polymerization mixture prior to removing the alcohol. Flexible hydrophilic coatings also are provided by adding glycerin to the polymerization mixture prior to removing the alcohol by drying. A method is also provided for the preparation of a gel free hydrophilic polymer substantially in the absence of a chain transfer agent comprising a copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate, including introducing monomeric 2-hydroxyethyl methacrylate containing no more than about 0. The alcohol is selected from one of methanol and ethanol, with ethanol being preferred. A method is also provided for the preparation of a gel free hydrophilic copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 2-hydroxyethyl methacrylate containing no more than about 0. In a preferred embodiment, the alcohol is selected from one of methanol and ethanol, with ethanol being preferred. In another embodiment, the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is blended with a polyalkylene glycol, such as polyethylene glycol, to form a pressure sensitive adhesive. The invention also provides a method for the preparation of a gel-free homopolymer of 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 4-hydroxybutyl acrylate into alcohol, and polymerizing the 4-hydroxybutyl acrylate to form a polymerization mixture. In another embodiment, the present invention provides a method for the preparation of a gel free hydrophilic homopolymer of 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent comprising introducing monomeric 4-hydroxybutyl acrylate into a solution of water and alcohol, and polymerizing the 4-hydroxybutyl acrylate. In another embodiment, the present invention provides a method for the preparation of a gel free hydrophilic homopolymer of 2-hydroxyethyl methacrylate

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substantially in the absence of a chain transfer agent comprising introducing monomeric 2-hydroxyethyl methacrylate containing no more than about 0. These homopolymers of 2-hydroxyethyl methacrylate prepared are stable in solution. The method includes introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of no more than about 0. Polymerization is induced by free radical initiation, and the alcohol is preferably removed by coating a substrate and drying the mixture. The controlled level of impurities results in the gel free polymer, even without using ultra-pure monomer. As described above, free radical polymerization is initiated by a suitable initiator. The initiator must be soluble in the alcohol and the 2-hydroxyethyl methacrylate monomer mixture. The method of the present invention, therefore, provides for the cost effective preparation of a gel-free poly 2-hydroxyethyl methacrylate, substantially in the absence of a chain transfer agent, using industrial grade 2-hydroxyethyl methacrylate monomer. A 2-hydroxyethyl methacrylate monomer suitable for use in the method of the present invention is available from Mitsubishi Rayon, Japan. In another embodiment, the present invention provides a method for the preparation of a gel-free poly 2-hydroxyethyl methacrylate substantially in the absence of a chain transfer agent, to achieve a hydrophilic pressure sensitive adhesive. The method includes introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. Polymerization is induced by free radical initiation, and alcohol removal is preferably accomplished by coating the mixture onto a substrate and drying the mixture. Although the preferred polyalkylene glycol used to prepare the pressure sensitive is polyethylene glycol, other polyalkylene glycols, such as polypropylene glycol may be used. In addition, copolymers of ethylene and propylene glycol may also be used to form the pressure sensitive adhesive. The hydrophilic pressure sensitive adhesives formed by this method have utility in many label and tape applications, and is particularly suitable for medical applications. In yet another embodiment, the present invention provides a method for the preparation of a flexible hydrophilic coating comprising a gel-free poly 2-hydroxyethyl methacrylate produced substantially in the absence of a chain transfer agent. The method comprises introducing monomeric 2-hydroxyethyl methacrylate containing ethylene glycol dimethacrylate impurities in the range of about 0. Polymerization is induced by free radical initiation, and alcohol removal by coating the mixture and drying. The flexible hydrophilic coating formed by this method has utility in skin-friendly applications in which a high Moisture Vapor Transmission Rate MVTR is needed together with protective, skin barrier properties. The coating is also suitable for printable coatings, such as inkjet coatings for paper, plastic film, and the like. In another embodiment, the present invention provides a method for the preparation of a gel free hydrophilic polymer substantially in the absence of a chain transfer agent comprising a copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate, including introducing monomeric 2-hydroxyethyl methacrylate containing 0. The copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is a hydrophilic copolymer that is insoluble in water and does not require crosslinking for water resistance. In addition, the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is flexible enough to form a flexible coating or film for medical and skin care or skin protection applications without the need for the addition of glycerin. The flexible coating comprising the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is also useful as a Rubber or latex glove coating, with particular usefulness in wet-donning applications. The copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate provides a flexible, non-tacky glove coating that allows the donning, wet or dry, of the Rubber or latex glove with minimal blocking and without undue friction or clinging. In another embodiment, the copolymer product of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate may further contain up to about 10 weight percent of an additional monomer, based on the weight of the copolymeric product. More preferably, the copolymeric product may contain from about 2 to about 4 weight percent of the additional monomer. The inclusion of up to about 10 weight percent of the monomer increases the cohesive strength of the copolymer, while still maintaining pressure sensitive adhesive

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properties, skin coating properties, and water resistance. Useful monomers include alkyl acrylates, alkyl methacrylates, hydroxyalkyl acrylates, hydroxyalkyl methacrylates, N-vinyl lactams, vinyl acetate and styrene monomers. The present invention, therefore, provides a gel-free, hydrophilic copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate that does not to be plasticized with either water or glycerin. The copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is a water-insoluble, water-absorbing, amphiphilic, elastic, abrasion resistant and has improved mechanical properties. The copolymer is prepared by introducing monomeric 2-hydroxyethyl methacrylate with 4-hydroxybutyl acrylate into a solution of water and alcohol. The monomeric 2-hydroxyethyl methacrylate should contain ethylene glycol dimethacrylate impurities in the range of about 0. The copolymerization reaction of the monomeric 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is carried using a water-soluble initiator system. The use of a water-soluble initiator system results in a more efficient conversion of monomers into copolymer product and, therefore, reducing the amount of residual monomer remaining after the copolymerization reaction. Reducing the amount of residual monomer remaining in the polymerization mixture avoids the need of an extensive leaching process to remove the residual monomers and the remaining water-soluble initiator, which results in a time and cost savings. In general, the copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can be utilized as a topical skin coating or barrier. Some useful applications of the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate includes use as sprayable carriers for topical application of drugs to the skin. For this application, the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate may be mixed with an alcohol or glycol solution to produce a sprayable vehicle or carrier that can be sprayed directly onto the skin. The copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate may also be a component of a transdermal drug delivery system. Specifically, the water-insoluble copolymer can be used as a carrier or vehicle to deliver an effective amount of a pharmacologically active agent drug transdermally. In this embodiment, the copolymer may be loaded with an effective amount of a pharmacologically active agent and locally placed on the surface of the skin. The transdermal drug delivery system can also include, as known in the art, skin permeation enhancers to facilitate the transdermal delivery of the pharmacologically active agent. The copolymer performs a dual function as a carrier of a pharmacologically active agent and a protective coating or skin barrier. The copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can be sprayed onto the skin before the application of adhesive-coated bandages, tapes, or other adhesive-coated medical devices to prevent irritation of sensitive skin. The copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can be used as an elastomeric medical film. Preferably, the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can be coated onto a substrate, such as a release liner and dried. The copolymer will be self cross-linking with heat treatment. The elastomeric medical film can be used directly over a wound on the skin to provide a dressing or barrier. The elastomeric film is soft and pliable, and easily conforms to the contours of human skin. The copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can be used as a coating for gloves, such as rubber or latex medical gloves. The use of the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate to coat a rubber or latex glove reduces the friction between the inner surface of the glove and the skin surface of the person donning the glove, especially under conditions of wet donning. The use of the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate as a glove coating, therefore, alleviates the need for the use of powder or other lubricating materials with the gloves. The copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate may also be included in sun block and sunscreen lotions, creams and sprays. The copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can be used as a carrier for water resistant cosmetic products. The cosmetic composition comprising the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate is easy to apply to and remove from the surface of human skin, it is non-greasy, and non-occlusive. Like skin, the

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copolymers of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate are water insoluble, hydrophilic, amphiphilic, elastic and abrasion resistant. The copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can also be included as a component of a nasal spray or other mucus membrane drug delivery systems, as a carrier for a pharmacologically active agent, such as a pharmaceutical. Using a mucus membrane drug delivery system is a potential benefit over ingestion of pills, tablets or capsules, or repeated injections of pharmacologically active agents, because these traditional methods have initially high concentrations of the pharmacologically active agent, which may be toxic or cause side effects to the target organ or surrounding structures. As time passes, the concentration of the pharmacologically active agent diminishes and another dosage is required to maintain the pharmacologically effective level. Utilizing a mucus membrane drug delivery system including the copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate as a carrier for a pharmacologically active agent may permit the delivery of an effective amount of a pharmacologically active agent and maintenance of the pharmacologically effective level over longer periods of time. The pressure sensitive adhesive product can be coated onto a substrate, such as a release liner. The pressure sensitive adhesive products can be used as a bandage, tape, wound dressing, surgical drapes and ostomy site dressings. The copolymer of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate can further be used as a lubricant for speed swimming. The copolymer may be applied to the skin of a swimmer, for example prior to competitive swimming events. As described above, the copolymer may be applied to the skin of a swimmer by spraying the copolymer directly onto the skin. In another embodiment, the copolymer product of 2-hydroxyethyl methacrylate and 4-hydroxybutyl acrylate, prepared in a solution of water and alcohol, may further contain up to about 10 weight percent of an additional monomer, based on the weight of the copolymeric product. More preferably, the copolymeric product may contain from about 2 to about 4 weight percent of the monomer. In another embodiment, the present invention provides a method for the preparation of a gel free hydrophilic homopolymer of 4-hydroxybutyl acrylate substantially in the absence of a chain transfer agent. The method includes introducing monomeric 4-hydroxybutyl acrylate into a solution of water and alcohol, and polymerizing the 4-hydroxybutyl acrylate. As described above, the alcohol is selected from one of methanol and ethanol, with ethanol being preferred. In another embodiment, the invention also provides a method for the preparation of a gel-free homopolymer of 4-hydroxybutyl acrylate in alcohol and substantially in the absence of a chain transfer agent comprising. The monomeric 4-hydroxybutyl acrylate is introduced into an alcohol solution. The monomeric 4-hydroxybutyl acrylate is polymerized to form a polymerization mixture. In another embodiment, the invention provides substrates coated with the homopolymer of 4-hydroxybutyl acrylate prepared in a solution of water and alcohol and a method of coating a substrate comprising applying to the substrate the polymerization mixture of a homopolymer of 4-hydroxybutyl acrylate prepared in a solution of water and alcohol and, thereafter, removing the alcohol and water from the polymerization mixture. In a preferred embodiment, the substrate is a release liner. In another embodiment, the invention provides a method of coating a substrate comprising applying to the substrate the polymerization mixture of a homopolymer of 4-hydroxybutyl acrylate prepared in a solution of water and alcohol, and further comprising adding a polyalkylene glycol to the polymerization mixture prior to the removing of the alcohol and water, and thereafter removing the alcohol from the polymerization mixture to form a hydrophilic pressure sensitive adhesive upon removing the alcohol and water from the polymerization mixture.

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Chapter 6 : Applications of pressure sensitive products crc press () by Lucio Cornejo - Issuu

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