PATENT SEARCH REPORT

Search Date:	13 December 13	Search Subject:	HEAT BLOCKING SYSTEM UTILIZING PARTICULATES
To:	SAMPLE	Search Type:	US Patents US Patent Applications EP Documents WIPO (PCT) German Patents Japanese Abstracts Non-Patent Literature
Search Fee:	**$200.00**		

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- ☐ A thorough search was conducted, but no relevant patents were found.
- ☐ A thorough search was conducted, and relatively few relevant patents were found. These are categorized in two groups in the following pages. The “A” group are most relevant, and the “B” group are appear relevant in some way but are mostly provided to illustrate surrounding technologies. (The B group may also include some A group patents.)
- ☑ A thorough search was conducted, and a fairly large number of patents were found. These are categorized in two groups in the following pages. The “A” group are most relevant and recent, and the “B” group either appear relevant in some way or appeared relevant but were older references. The abstracts or patents in this group should be reviewed carefully by the client for relevance, as there may also be highly-relevant references in this group. (The B group may also include some A group patents.)
- ☐ A thorough search was not able to be conducted, but a few patents are listed that may be relevant. Reason for inability to perform a thorough search:
- ☐ A manual search is needed for this type of search. Your search fee has been refunded and the work performed on this search is complimentary.

Concepts and key-words used in this search (note that the symbol * designates a wild-card, so door* = door, doorway, etc.)**:**

(paint OR coating OR subcoating OR film OR varnish OR system)
(particle* OR nanoparticle* OR microparticle* OR nanocrystal* OR granule* OR microsphere* OR spherical)
(multilayered OR multilayering OR "multi-layered" OR "multi-layering" OR laminate* OR lamination* OR "multiple layers")
("heat blocking" OR "heat resistant" OR solar OR infrared OR fireproof OR "electromagnetic waves" OR wavelength)
(reflect OR refract)
(transmit OR absorb)
(filler*)
(void*)

US Patent Classifications Searched:

106	COMPOSITIONS: COATING OR PLASTIC
156	ADHESIVE BONDING AND MISCELLANEOUS CHEMICAL MANUFACTURE
252	COMPOSITIONS
359	OPTICAL: SYSTEMS AND ELEMENTS
427	COATING PROCESSES
428	STOCK MATERIAL OR MISCELLANEOUS ARTICLES
523	SYNTHETIC RESINS OR NATURAL RUBBERS -- PART OF THE CLASS 520 SERIES
524	SYNTHETIC RESINS OR NATURAL RUBBERS -- PART OF THE CLASS 520 SERIES
977	NANOTECHNOLOGY

Notes and Opinion from the Researcher:

The disclosed multi-layered coating system involves multiple layers of subcoated layers, wherein each subcoating layer comprises a plurality of well separated spherical particulates and a plurality of well separated spherical voids that are randomly distributed inside of said subcoating layer. The selective filtering of electromagnetic wavelengths in the disclosed multi-layered coating system depends on the particular arrangement of subcoating layers, wherein each subcoating layer is characterized by spherical particulates and spherical voids of unique diameter sizes.

The principal object of the invention is to provide a multi-layered coating system that improves insulation against heat loss by blocking infrared radiation.

The other object of the present invention is to provide a versatile device for selectively filtering electromagnetic waves, wherein the range of operation is not just limited to infrared wavelengths but also covers wavelengths that are of technological importance, such as those wavelengths (or frequencies) used by the broadcasting and communications industries as well as by the military.

Based on my review of the patents generated in this report, there are prior art examples that disclose one or some of the novel aspects of the present invention, but not all. While there is a possibility of a Section 102 rejection, the strength of application may well overcome that rejection in office action arguments. The very broad second objective may potentially bring in prior art not technically related to the present invention, and has a greater likelihood of a Section 103 rejection.

It should also be noted that there is no guarantee that a patent search is ever totally complete. The United States patent system presently includes almost seven million U.S. patents which are classified and cross-classified within one or more of 125,000+ classification areas. It is, therefore, exceedingly difficult to be more than reasonably certain that the most pertinent patent art has been located. Before you make large investments into your invention in terms of developing prototypes, tooling, production runs, and the like, you are advised that the issuance of a U.S. Patent is the final word in terms of patentability.

PATENT SEARCH ANALYSIS

CATEGORY	DOCUMENT	RELATED DOCUMENTS	PUBLICATION DATE	TITLE	ABSTRACT
A	US20130108873A1	CA2680482A1 US8361597 US20080241472 WO2008121749A1	May 2, 2013	Solar heat-reflective roofing granules, solar heat-reflective shingles and process for producing same	Solar-reflective roofing granules having improved solar heat-resistance are formed by coating colored mineral particles with a coating composition including titanium dioxide nanoparticles.
A	US20130161578A1	CA2688279A1 US8394498 US20100151199	Jun 27, 2013	Roofing granules with high solar reflectance, roofing materials with high solar reflectance, and the process of making the same	Roofing granules include a core having an average ultraviolet transmission of greater than sixty percent and an average near infrared reflectance of greater than sixty percent and a UV coating layer on the exterior surface. The coating provides UV opacity, while the core provides near infrared reflectance.
A	US20130107355A1	CN103003728A EP2597496A1 WO2012014607A1	May 2, 2013	Near-infrared reflecting film and near-infrared reflecting body provided with same	The present invention provides a highly flexible near-infrared reflecting film which has achieved good near-infrared reflection characteristics by comprising layers that have different refractive indexes and which is not susceptible to bending or cracks. This near-infrared reflecting film has a multilayer film, in which films having refractive indexes different from each other are laminated, on a film, and is characterized in that: the difference of the refractive indexes between at least two adjacent layers is 0.3 or more; at least one of the two adjacent layers contains a metal oxide; and at least one of the two adjacent layers contains a polyvinyl alcohol or an inorganic polymer.
B	US20110123788A1	CA2773045A1 WO2011024020A1	May 26, 2011	Thin Films Including Nanoparticles With Solar Reflectance Properties for Building Materials	Disclosed are solar-reflective building materials, including roofing articles, that include nanoparticle-containing thin films; such articles display high reflectance of near-infrared radiation and high transmission of radiation in the visible light range so as to reduce the heat island effects experienced by the articles while also maintaining an aesthetically pleasing appearance. Also disclosed are related methods of fabricating such articles.
A	US20090153953A1	N/A	Jun 18, 2009	Multi-Layer Photonic Structures Having Omni-Directional Reflectivity and Coatings Incorporating The Same	A multi-layer photonic structure may include alternating layers of high index material and low index material having a form $[H(LH)^N]$ where, H is a layer of high index material, L is a layer of low index material and N is a number of pairs of layers of high index material and layers of low index material. N may be an integer $\geqq 1$. The low index dielectric material may have an index of refraction n_L from about 1.3 to about 2.5. The high index dielectric material

					may have an index of refraction n_H from about 1.8 to about 3.5, wherein $n_H>n_L$ and the multi-layer photonic structure comprises a reflectivity band of greater than about 200 nm for light having angles of incidence from about 0 degrees to about 80 degrees relative to the multi-layer photonic structure. The multi-layer photonic structure may be incorporated into a paint or coating system thereby forming an omni-directional reflective paint or coating.
A	US20080075948A1	CN101522412A, EP2073981A1, EP2073981A4, US7906202, WO2008039688A1	Mar 27, 2008	Tear resistant solar control multilayer film	A tear resistant solar control multilayer film article is disclosed. The multilayer film article includes an infrared light reflecting multilayer film having alternating polymeric layers of a first polymer type and a second polymer type and the alternating polymeric layers cooperate to reflect infrared light; an infrared light absorbing nanoparticle layer including a plurality of metal oxide nanoparticles dispersed in a cured polymeric binder, the infrared light absorbing nanoparticle layer being adjacent the infrared light reflecting multilayer film, and a tear resistant polymeric film disposed adjacent to the infrared light reflecting multilayer film.
A	US20060285210A1	US7094461 US20040126549 WO2004061492A1	Dec 21, 2006	Multilayer optical film with nanoparticles	Multilayer optical films, including but not limited to p-polarizing films, have alternating optical layers at least some of which contain nanoparticles in an amount sufficient to enhance the refractive indices of the optical layers.
B	US7745003B2	CN1918247A CN1918247B DE102004006145A1 EP1711562A2 US20070166544 WO2005075578A2 WO2005075578A3	Jun 29, 2010	Particles having a functional multilayered structure	The present invention relates to particles having a functional multilayered structure based on substrates, characterized in that the substrates are coated with one or more layers of one or more polymers and one or more layers of one or more silanes, process for the production thereof, and the use thereof.
B	US6017981A	CA2209901A1 CA2209901C CN1152928C CN1172492A DE19501114A1 DE19501114C2 EP0804513A1 EP0804513B1 WO1996022337A1	Jan 25, 2000	Coating material with reflective properties in two wavelength ranges, and absorbent properties in a third wavelength range	A coating material having reflective properties in two wavelength ranges and absorbent properties in a third wavelength range. The coating material comprises a binder, flaky first particles, and second particles. The binder has a transparency greater than 40% in the wavelength ranges of from 0.4 to 0.7 µm and from 10 to 50 µm and a refractive index n in the wavelength ranges less than 2 The coating material comprises from 20 to 30 percent by weight, based on the wet weight of the coating material, of the flaky first particles. The flaky first particles have a thickness less than 10 µm and a surface area (length greater than 100 µm.sup.2 and a reflectivity R greater than 40% in the wavelength range of from 10 to 50 µm. The second particles at least partially overlap the first particles. The second particles have a transparency greater than 40% only in the wavelength ranges of from 0.4 to 0.7 µm and from 10 to

					50 µm, but an absorption greater than 20% in the wavelength range of from 1.0 to 2.0 µm, as well as a refractive index in the wavelength range of from 0.4 to 0.7 µm greater than that of the binder. The size of the second particles are selected such that there is an optimum back scattering and thus reflective effect in the wavelength range of from 0.4 to 0.7 µm.
B	WO2012166747A2	WO2012166744A1 WO2012166745A1	Dec 6, 2012	Multi-layer coating with cubic boron nitride particles	A physical configuration of multiple-layer coatings formed with at least one layer of coating containing cubic born nitride (cBN) particles with one or more layers in composite form containing cBN particles may have a thickness of each individual layer as thin as in the nanometer range, or as thick as in the range of a few microns and even up to tens of microns. The chemistry of the composite layer consists of any individual phase of (a) nitrides such as titanium nitride (TiN), titanium carbonitride (TiCN), and hafnium nitride (HfN); (b) carbides such as titanium carbide (TiC); and (c) oxides such as aluminum oxide (Al_2O_3) or any combination of the above phases, in addition to cBN particles. The coating or film can be stand-alone or on a substrate.
A	US20080081207A1	EP2072245A1 EP2072245A4 US7955662 WO2008041382A1	Apr 3, 2008	Optical multilayer reflective film, and aligned metal particle film and manufacturing process therefor	An aligned metal-particle film, in which metal particles are aligned in a polymer as a layer with a certain interval in parallel with a substrate is disclosed. The aligned metal-particle film is manufactured by forming a polymer film containing a metal component on a reflecting substrate; and irradiating the polymer film with light at a particular wavelength, whereby metal particles are aligned in parallel with the substrate in the polymer.
A	JP2009203434	N/A	Sep 10, 2009	HIGHLY HEAT-RESISTANT RUBBER FILM COMPRISING MULTILAYER-STRUCTURAL POLYMER PARTICLE, AND MANUFACTURING METHOD THEREFOR	PROBLEM TO BE SOLVED: To provide a highly heat resistant rubber film having excellent heat resistance and impact resistance, and a manufacturing method therefor. SOLUTION: This heat resistant rubber film is a film obtained by heat-molding a multilayer-structural polymer particle having specific chemical structure in the outermost layer and having a rubber component layer in the innermost layer, under a specific condition, and is provided with excellent transparency, heat resistance and impact resistance. A film similar thereto is also provided when heat-molding a rubber dispersion comprising the multilayer-structural polymer particle. The film obtained by this manner is used suitably, in particular, for an in-vehicle or out-vehicle automobile component and an optical component requiring high heat resistance and molding workability.

B	US7858953B2	CA2666195A1 US20090289199	Dec 28, 2010	Use of fluorescent nanoparticles to measure individual layer thicknesses or composition in multi-layer films and to calibrate secondary measurement devices	Fluorescent nanoparticles such as quantum dots are incorporated into plastic, paper and other web layered products to achieve cross-direction and machine direction on-line analysis of the individual layers therein. Fluorescent nanoparticles markers are added in known proportions into product formulations. By detecting the fluorescence from the nanoparticles, the thickness and other physical characteristics of the web can be traced at various stages of production. In addition, by using different populations of fluorescent nanoparticles that emit radiation at different wavelengths, data from individual layers in a composite structure can be ascertained simultaneously with a single sensor. The technique is particularly suited for monitoring difficult-to-measure polymers in complex multilayer structures.
A	US20110297436A1	CN102341232A WO2010101028A1	Dec 8, 2011	Net-like metal fine particle multilayer film and method for producing same	A network-like fine metal particle multilayer film has a network-like fine metal particle layer at least on one surface of a film substrate, which has an average total light transmittance of 70% or more, a total light transmittance variation of 5% or less, and a length of 2 m or more. The film is a long network-like metal fine particle multilayer film having high transparency, being suppressed in the occurrence of moiré and having small variations in the total light transmittance.
A	JP2010241638	N/A	Oct 28, 2010	THIN FILM LAMINATE WITH METAL NANOPARTICLE LAYER INTERPOSED	PROBLEM TO BE SOLVED: To provide a transparent thin film laminate with a low specific resistance. SOLUTION: The thin film laminate comprises a ZnO thin film layer formed on a substrate, a metal nanoparticle layer formed on the ZnO thin film layer and another ZnO thin film layer formed on the metal nanoparticle layer, provided that the metal nanoparticle layer interposed between the two crystalline ZnO thin film layers has a structure comprising a metal nanolayer composed of metal nanoparticles that are connected to each other. The obtained thin film laminate has a specific resistance of ≤8.0×10-4 Ωcm and a visible light transmittance of ≥70%. The thin film laminate can be used as a transparent conductive film, a photovoltaic electrode, an electromagnetic wave shielding material, etc.
B	US20130295331A1	EP2657730A1 CN103384839A WO2012086748A1	Nov 7, 2013	Film containing metal oxide particles, transfer film and method for producing same, and laminate and method for producing same	Provided is a transfer film that includes, as a medium-refractive-index film, a film containing metal oxide particles that has a central region in which there are no metal oxide particles, a surface-layer region (a**1**) formed on one side of the central region and including metal oxide particles, and a surface-layer region (a**2**) formed on the opposite side of the central region and including metal oxide particles, the transfer film being capable of providing a laminate that has excellent stain resistance, anti-reflection characteristics,

					transparency, sweat resistance, and scratch resistance, and in which interference patterns are reduced. By using said transfer film, it is possible to obtain a laminate that has excellent stain resistance, anti-reflection characteristics, transparency, sweat resistance, and scratch resistance, and in which interference patterns are reduced.
A	US6773801B2	US20020146555	Aug 10, 2004	Fine particle layer laminated film and optical functional material	The present invention discloses a fine particle layer laminated film configured in such a manner that a plurality of fine particle layers containing the fine particles, of which average particle diameters are in the range of 1 nm and 95 nm, are laminated; wherein the fine particles in the fine particle layer laminated film are accreted by polymer molecules; there are air spaces within a film of the fine particle layer laminated film; and a density of the fine particles in the fine particle layer laminated film is in the range of 40% and 80% in percentage by volume. According to the present invention, it is possible to obtain a laminated film sufficiently having a property of the fine particle, for example, a property such as a low index of refraction or the like. Therefore, the present invention has an effect such that the fine particle layer laminated film according to the present invention can be preferably used for an application such as an antirelection film or the like.
B	US5279881A	CA2077417A1 DE69207519D1 DE69207519T2 EP0530774A1 EP0530774B1	Jan 18, 1994	Laminated polyester film for magnetic recording medium comprising specific particles	A laminated polyester film for a magnetic recording medium which has a first polyester layer (A) containing inorganic particles (a) having a Moh's hardness of at least 8 and a specific average particle size and inactive particles (b) having a Moh's hardness of less than 8 and a specific average particle size larger than that of the particle (a) and a second polyester layer (B) containing inactive particles (c) having a Moh's hardness of less than 8 and a specific average particle size, wherein a content of the particles (a) is from 0.25 to 5% by weight based on the weight of the polyester in the layer (A) and less than 0.15% by weight of the whole weight of the polyester in the layers (A) and (B), the contents of the particles (b) and (c) are each 0.05 to 2.0% by weight of the polyester in the layers (A) and (B), respectively, and exposed surfaces of the layers (A) and (B) have coefficients of friction and surface roughness (Ra) which satisfy the specific conditions.
B	US8475927B2	CA2550016A1 CA2550016C CN1898174A CN1898174B EP1698599A1 EP1698599A4 US8221535	Jul 2, 2013	Tin-doped indium oxide fine particle dispersion, method for manufacturing the same, interlayer film for laminated glass with heat ray blocking properties formed by using said dispersion, and laminated glass therewith	A dispersion of tin-doped indium oxide fine particles has tin-doped indium oxide fine particles, a plasticizer for an interlayer film, an organic solvent containing alcohols as a main component, and a dispersion stabilizer, wherein under measuring conditions of a concentration of tin-doped indium oxide fine particles of 0.7% by weight and an optical path length of a glass cell of 1 mm, a visible light transmittance is 80% or more, a solar radiation transmittance at a wavelength within a range from 300 nm to 2100 nm is ¾ or less of the

		US20060225614 US20120258297 WO2005061405A1			visible light transmittance, a haze value is 1.0% or less, and a reflection yellow index is −20 or more.
B	US5336079A	CA2062480A1 DE69213052D1 DE69213052T2 EP0502745A2 EP0502745A3 EP0502745B1 EP0502745B2 EP0502745B9	Aug 9, 1994	Biaxially oriented laminated film comprising particles in a specific ratio of particle density	Disclosed is a biaxially oriented laminated film having at least three layers which has excellent abrasion resistance and electromagnetic conversion property when the film is used as the base film of a magnetic recording media. The biaxially oriented laminated film comprises at least one outermost layer containing particles A, the particle density ratio at surface layer of the particles A is not less than 0.01, and the mean primary particle size D of the particles A and the thickness T of the outermost layer containing the particles A satisfies the equation; $D \leqq T \leqq 200D$.
B	US7781042B2	CN101025967A CN101025967B DE602007010681D1 EP1826758A1 EP1826759A1 EP1826759B1 US20070202441	Aug 24, 2010	Optical storage medium using nanoparticles	The present invention relates to an optical storage medium using nanoparticles, and more specifically to a multi-layer optical storage medium. According to the invention, the optical storage medium has two or more storage layers with nanoparticles, each storage layer being made of a dielectric material, wherein the dielectric materials of at least two storage layers have a different dielectric permittivity.
B	JP2013129614	N/A	Dec 20, 2011	ULTRAVIOLET SHIELDING COMPOSITE PARTICLE, ULTRAVIOLET SHIELDING MULTILAYER COMPOSITE PARTICLE, ULTRAVIOLET SHIELDING DISPERSION, AND COSMETIC	PROBLEM TO BE SOLVED: To provide an ultraviolet shielding composite particle that has a high UV-A shielding property though the content of a dibenzoylmethane derivative that is an ultraviolet shielding agent is low, and that can efficiently shield especially the ultraviolet in a long-wavelength side, and especially the ultraviolet on the wavelength band region of 380-400 nm, and to provide a dispersion and a cosmetic containing the ultraviolet shielding composite particle. SOLUTION: The ultraviolet shielding composite particle is characterized in that a resin composition that contains a dibenzoylmethane derivative in a second resin is made to adhere to the whole surface or one part of the surface of a core part consisting of a first resin to make a coating film or at least one island-like object, and the content of the dibenzoylmethane derivative is at least 20 mass% and at most 60 mass%.
B	US7348056B2	CN1614447A CN100397100C DE602004020018D1 EP1482330A1 EP1482330B1	Mar 25, 2008	Fine particle dispersion composition, optical component, optical film laminate, polarization splitting device, and method for manufacturing the optical	The invention provides a fine particle dispersion composition that does not depend on a curing method and that has adaptability to the curing methods and versatility and can provide a highly transparent optical component, an optical component using the fine particle dispersion composition and a method of manufacturing the same, and an optical film laminate using the

		US20050163971		component	optical component, and also provides a polarization splitting device using the optical component. In order to achieve the above, there is provided an optical component, which is obtained by curing a fine particle dispersion composition, which comprises metal-oxide fine particles, an organic resin material adapted to cure by absorbing energy, one of a polyoxyethylene alkyl ether phosphoric acid-based surfactant and a polyoxyethylene alkyl ether carboxylic acid-based surfactant, each of which has a molecular weight of 500 or more, and an organic solvent.
B	US7332229B2	CN1646640A CN100339446C US20050159509 WO2003087235A1	Feb 19, 2008	Varnish, shaped item, electrical insulating film, laminate, flame retardant slurry and process for producing flame retardant particles and varnish	The invention provides a varnish that contains an insulting resin, a curing agent, a flame retardant, and an organic solvent. The flame retardant comprises flame retardant particles surface treated with at least one surface treatment agent selected from the group consisting of a phosphorus compound soluble in an organic solvent, an organosilicon compound and a dispersant having a carboxyl group. A formed material is obtained by applying and drying the varnish on a substrate. A multilayer structure is obtained by forming on a substrate having a conductor circuit layer an electrical insulation layer obtained by curing the formed material obtained from the varnish.
B	US5126192A	EP0440918A2 EP0440918A3	Jun 30, 1992	Flame retardant, low dielectric constant microsphere filled laminate	A flame retardant, low dielectric constant, controlled coefficient of thermal expansion, low cost prepreg material which includes randomly distributed silane coated hollow microspheres has been prepared by standard impregnation and lamination techniques. Laminates made of this prepreg can be drilled cleanly for through holes and can be used as a substrate for surface mounted devices.
B	US6399228 B1	DE69716624D1 DE69716624T2 EP0927371A1 EP0927371B1 EP1227346A2 EP1227346A3 WO1998012583A1	Jun 4, 2002	Multi-layer interference coatings	A multi layer interference coating comprising at least one multi layer stack deposited on a reflective layer (**9**), wherein each multi layer stack comprises a first dielectric layer (**11**), a layer of asbsorbing material (**10**) and a second layer of dielectric material (**11**) arranged in series and having a reflectance spectrum in the infrared region comprising at least one maximum. The dielectric layers are of equal optical thickness and typically are of the same material. The multi layer structure of the coating is such that incident electromagnetic radition, for which odd multiples of half wavelengths correspond to the optical thickness of the multi layer coating at the incident wavelength do not propagate within the coating and reflection at these wavelengths, is suppressed. Coatings may therefore be designed to have a near satured color in the visible wavelength spectrum. The reflective layer may be a metal or a conducting oxide, a conducting nitride, a conducting silicide or a conducting sulphide. The absorbing layers may be Cr, V, Pd, Ni, Pt, conducting oxides, or substoichiometric metal oxides, such as TiO_x. In one

					form of the coating, where a non-metal absorber is used, the second dielectric layer may be removed in at least one of the multi layer stacks. The coating may be incorporated in a system for verifying the authenticity of an article.
B	Canadian Journal of Chemistry	N/A	Mar 2010 Vol. 88 Issue 3 p298-304	Hybrid microspheres with alternating layers of a polymer and metal nanoparticles	We studied the optical properties of hybrid multilayer microspheres (HMMs). We prepared multilayer particles with alternating radial layers of gold nanoparticles (NPs) and poly(methyl methacrylate) and achieved control over particle size, the thickness of particle layers, and the surface coverage of gold NPs. We showed the ability to tune the spectral characteristics of the HMMs, which was based on frequency dispersion of the dielectric constant of polymer–metal NP structures. Good agreement between experimental and theoretical extinction properties of the HMMs was obtained. In comparison with multilayer structures synthesized solely from polymers, hybrid multilayer microspheres have a larger refractive layer contrast between adjacent layers, which is important for practical applications in optoelectronic devices.
B	ASHRAE Journal	N/A	Jul 2009 Vol. 51 Issue 7	Technologies for Smart Windows	Two systems are discussed, with a focus on energy savings and advanced functionality. Metal Oxide Electrochromics technology consists of a five-layer metal oxide coating sandwiched between two sheets of glass. The layers are 1. Conductive layer; 2. Positive ion storage layer-colorless lithium metal oxide; 3. Conductor/electrolyte layer; 4. Electrochromatic layer-negative tungsten oxide; and 5. Conductive layer. Suspended Particle Device (SPD) glass consists of two panes of glass (or transparent plastic) with conductive coatings on the inside surfaces. A film layer containing suspended small particles of carefully designed chemical composition is sandwiched between the two panes. The normal distribution of the particles is such that they are randomly oriented and block up to 99.75% of incident light from passing through the glass. When ac voltage is applied to the conductive layers, the suspended particles orient in the electrical field and allow light to pass. By adjusting the applied voltage, the glass can be infinitely controlled from more transparent than typical building windows to almost totally opaque.

B	Polymer Engineering and Science	N/A	Aug 2002 Vol. 42 Issue 8	High performance films: review of new materials and trends	This paper reviews some modern aspects and trends in the development of high performance polymer materials and processing technologies providing fabrication of advanced film and film structures. Changes in understanding of technical requirements and properties, along with novel approaches in creating high performance films of various thermoplastic materials, are discussed. The most important groups of polymer materials being used in high performance applications are described.

PRIOR ART NAMED IN CURRENT PATENT APPLICATION

CATEGORY	DOCUMENT	RELATED DOCUMENTS	PUBLICATION DATE	TITLE	ABSTRACT
A	US4623390A	N/A	Nov 18, 1986	Insulating paint for interior and exterior of buildings and method of making same	An insulating paint for exteriors or interiors of buildings includes glass microspheres or hollow glass extenders, having a density of about 0.22 to 0.28 grams per cubic centimeter, and a diameter of about 100 microns. The microspheres are dispersed by high speed mixing in the grind stage of the paint formulation. The paint provides insulation against heat loss.
A	US8287998B2	US20050126441	Oct 16, 2012	Composition of a thermaly insulating coating system	A composition for a Coating System (paint) which forms an insulating material being designed to both reflect infrared radiation and have reduced thermal conductivity. The coating system may be either a single Thermal Coating or may be a Thermal Coating used in combination with a Thermal Primer. The Thermal Coating is formulated using conventional techniques and a resin used in paint manufacture, but utilizes primary pigments and extender mineral pigments which preferentially reflect in the infra red area of the solar spectrum. A method of characterizing particulate materials for their infra red reflectivity is described, which provides a means for preferential selection of particulate additives based on their relative visible light and infrared reflectivity. Additionally the incorporation of hollow micro-spheres is desired to reduce thermal conductivity. The Thermal Primer is designed to provide adhesion between the Thermal Coating and the substrate on which it is applied and uses conventional techniques to achieve those properties. However it has been found advantageous to incorporate hollow micro-spheres with low thermal conductivity, such as glass, ceramic or polymeric micro-spheres and/or an extender pigment with low thermal conductivity such as calcined clay to further reduce heat flow through the Coating System.
A	US8084528B2	DE102009054789A1 US20100168308	Dec 27, 2011	Heat-resistant paint	The present invention relates to heat-resistant paint which is capable of forming paint film that inhibits whitening even in high-temperature environments on the order of 350-650° C. The heat-resistant paint of the present invention contains silicone resin and/or epoxy resin as well as black pigment, wherein, said black pigment contains manganese and copper, the content of manganese in said black pigment is 25-45 mass % by MnO conversion, the content of copper in said black pigment is 5-25 mass % by CuO conversion, and the content of silicon in said black pigment is 3 mass % or less by SiO_2 conversion.

B	US20100203336A1	CA2688340A1 EP2165028A2 EP2165028A4 WO2008147972A2 WO2008147972A3	Aug 12, 2010	Roofing granules with high solar reflectance, roofing products with high solar reflectance, and processes for preparing same	Solar reflective roofing granules include a binder and inert mineral particles, with solar reflective particles dispersed in the binder. An agglomeration process preferentially disposes the solar reflective particles at a desired depth within or beneath the surface of the granules.
B	US7833342B2	CA2613596A1 CN101242948A CN101242948B EP1904290A2 US20080035021 WO2007002744A2 WO2007002744A3	Nov 16, 2010	Aluminum phosphate based microspheres	Aluminum phosphate-based microspheres and related compositions and methods of use.
A	US20070298242A1	N/A	Dec 27, 2007	Lenses having dispersed metal nanoparticles for optical filtering including sunglasses	Lenses appropriate for use as sunglasses and other optical filtering devices include one or more composite layers including metal nanoparticles dispensed in a polymer matrix. The entire lens can be a single layer of the composite or the composite can be a coating on one or both faces of the lens. Gold nanoparticles can be dispersed in a poly(methylmethacrylate) or polycarbonate polymer at 0.01 to 1 weight percent.
A	US20070036985A1	EP1736453A1 EP1736453A4 WO2005095298A1	Feb 15, 2007	Infrared ray-cutting glass and method of manufacturing the same	An infrared ray-cutting glass according to which the capability of an IR-cutting component can be sufficiently maintained while securing sufficient hardness. The IR-cutting glass **100** is comprised of a glass substrate **20**, and an IR-cutting film **10** containing ITO fine particles **12** as an infrared ray-cutting component. The IR-cutting film **10** is formed, using an infrared ray-cutting component not containing a fluorine component, on a surface of the glass substrate **20** by a sol-gel method carried out at a low temperature of less than 350° C. The IR-cutting glass **100** having the IR-cutting glass **10** has a haze of not more than 7% after a wear resistance test carried out on the surface on which the IR-cutting film **10** is formed.
A	US7760424B2	US20070297046	Jul 20, 2010	Infrared reflecting device	An infrared reflecting device includes a multi-layer infrared reflecting body composed of a plurality of superimposed infrared reflecting members, and temperature-sensitive members positioned surrounding the side faces of the multi-layer infrared reflecting body. The infrared reflecting member includes colloidal crystal particles arrayed at regular lattice spacing, and a filler interposed between the colloidal crystal particles. Depending on temperature, the temperature-sensitive members supply the filler with moisture, and the lattice spacing of the colloidal crystal particles changes due to swelling of the filler. Since lattice spacing changes the reflected wavelength from the ultraviolet region to the infrared region on the basis of Bragg's law and Snell's law, the amount of transmitted infrared radiation can be adjusted efficiently.

A	US8009351B2	US20090015908	Aug 30, 2011	Infrared reflective member, and infrared reflective device and method of making same	The infrared reflective device includes infrared reflective members which reflect infrared rays. The infrared reflective members include colloidal particles arranged at regular spacing, and a filler material intervening in the spaces between the colloidal particles. The difference between the refractive index of the colloidal particles and the refractive index of the filler material is set so as to be 0.05 or less in the visible light region and 0.1 or above in the infrared region, whereby visible light is transmitted while infrared rays are reflected.
A	US20130266800A1	CN103370440A EP2643493A1 WO2012071507A1	Oct 10, 2013	Colloidal infrared reflective and transparent conductive aluminum-doped zinc oxide nanocrystals	The present invention provides a method of preparing aluminum-doped zinc oxide (AZO) nanocrystals. In an exemplary embodiment, the method includes (1) injecting a precursor mixture of a zinc precursor, an aluminum precursor, an amine, and a fatty acid in a solution of a vicinal diol in a non-coordinating solvent, thereby resulting in a reaction mixture, (2) precipitating the nanocrystals from the reaction mixture, thereby resulting in a final precipitate, and (3) dissolving the final precipitate in an apolar solvent. The present invention also provides a dispersion. In an exemplary embodiment, the dispersion includes (1) nanocrystals that are well separated from each other, where the nanocrystals are coated with surfactants and (2) an apolar solvent where the nanocrystals are suspended in the apolar solvent. The present invention also provides a film. In an exemplary embodiment, the film includes (1) a substrate and (2) nanocrystals that are evenly distributed on the substrate.
B	US8362684B2	EP1070355A1 EP2309557A1 EP2325897A2 EP2325897A3 US6501091 US6803719 US6890777 US6914265 US7264527 US7692373 US8053972 US8174181 US20030127659 US20030127660 US20040259363 US20080174233 US20100140585 US20100141118 US20100176715	Jan 29, 2013	Quantum dot white and colored light-emitting devices	A light-emitting device comprising a population of quantum dots (QDs) embedded in a host matrix and a primary light source which causes the QDs to emit secondary light and a method of making such a device. The size distribution of the QDs is chosen to allow light of a particular color to be emitted therefrom. The light emitted from the device may be of either a pure (monochromatic) color, or a mixed (polychromatic) color, and may consist solely of light emitted from the QDs themselves, or of a mixture of light emitted from the QDs and light emitted from the primary source. The QDs desirably are composed of an undoped semiconductor such as CdSe, and may optionally be overcoated to increase photoluminescence.

		US20120012877 US20120280611 US20130207073 WO1999050916A1 WO1999050916A9			
B	US8395042B2	US20090255580 WO2009142677A2 WO2009142677A3	Mar 12, 2013	Quantum dot solar cell with quantum dot bandgap gradients	Efficient photovoltaic devices with quantum dots are provided. Quantum dots have numerous desirable properties that can be used in solar cells, including an easily selected bandgap and Fermi level. In particular, the size and composition of a quantum dot can determine its bandgap and Fermi level. By precise deposition of quantum dots in the active layer of a solar cell, bandgap gradients can be present for efficient sunlight absorption, exciton dissociation, and charge transport. Mismatching Fermi levels are also present between adjacent quantum dots, allowing for built-in electric fields to form and aid in charge transport and the prevention of exciton recombination.
B	US20130207073A1	EP1070355A1 EP2309557A1 EP2325897A2 EP2325897A3 US6501091 US6803719 US6890777 US6914265 US7264527 US7692373 US8053972 US8174181 US8362684 US20030127659 US20030127660 US20040259363 US20080174233 US20100140585 US20100141118 US20100176715 US20120012877 US20120280611 WO1999050916A1 WO1999050916A9	Aug 15, 2013	Quantum Dot White and Colored Light Emitting Devices	A light-emitting device comprising a population of quantum dots (QDs) embedded in a host matrix and a primary light source which causes the QDs to emit secondary light and a method of making such a device. The size distribution of the QDs is chosen to allow light of a particular color to be emitted therefrom. The light emitted from the device may be of either a pure (monochromatic) color, or a mixed (polychromatic) color, and may consist solely of light emitted from the QDs themselves, or of a mixture of light emitted from the QDs and light emitted from the primary source. The QDs desirably are composed of an undoped semiconductor such as CdSe, and may optionally be overcoated to increase photoluminescence.

B	US20130003163A1	N/A	Jan 3, 2013	Passive matrix quantum dot display	A system and method for operating a light emitting device utilizing charged quantum dots is described. In one embodiment, charged quantum dots are suspended in a liquid between an excitation plate and a cover plate. The excitation plate carries short-wave excitation light. Charged quantum dots near the surface of the excitation plate may emit light in response to an evanescent field generated by the short-wave excitation light undergoing total internal reflection within the excitation plate. The excitation plate and the cover plate may be coated with one or more transparent electrodes. The movement of charged quantum dots within the liquid may be controlled by applying one or more bias voltages to the one or more transparent electrodes. Light emission from a particular region near the surface of the excitation plate may be controlled by moving charged quantum dots into or out of the particular region.