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⑤④ **Electroded donor development device with dielectric overcoating.**

⑤⑦ An overcoating for an electroded donor development device includes injection enabling particles, charge transport molecules and an optional binder resin. This overcoating can be applied to the electrodes of electroded donor devices to protect the electrodes from wear and can also prevent shorting and breakdown.

This invention relates to electroded donor development systems and more particularly to improved overcoatings for electroded donor devices and methods of making the same.

Electroded donor development systems are used in electrostatographic processors for development of latent electrostatic images carried by an electrically insulative imaging surface as the imaging surface moves through a development zone (i.e., region where toner particles are transferred from a donor device to an imaging surface). For example, the imaging surface can be a photoconductive layer which is coated on an electrically conductive imaging member which, in turn, is held at a predetermined reference potential, such as ground.

The electroded donor development system has a housing for supporting at least one donor device adjacent the development zone. The donor device is spaced a predetermined, short distance from the imaging surface and is driven to bring toner near the imaging surface as it moves through the development zone. The toner on the electroded donor device is supplied by a magnetic brush development system. The developer may be a mixture of triboelectrically charged toner and carrier particles. An example of suitable toner particles which can be employed in a magnetic brush development system is described in US-A-3,977,871.

One of the main purposes of the magnetic brush development device is to transport developer into and through a toner loading zone under the influence of a magnetic field which is shaped to cause developer to form into bristle-like streamers which brush against the donor device surface. Those bristles or streamers are pronounced only in a relatively narrow region (hereinafter referred to as the "loading nip" region) which is more or less centered on the line along which the donor device makes its closest approach to the magnetic brush development device. The magnetic brush development device carries magnetically entrained developer from a pick-up point located upstream of the nip region to a discharge point located downstream of the nip region.

Electroded donor developer devices are known for xerographic development systems. Such devices are disclosed in US-A-5,172,170 and patent application Serial No. 07/724,242, attorney docket No. D/86305Q, filed July 1, 1991. Electroded donor devices also are described in US-A-3,996,892 and US-A-4,568,955. These electroded devices contain electrically isolated conductors embedded in an insulating layer. A conductive contact brush or roll at one end of the donor is used to apply AC/DC voltages to activate the electrodes. In the device disclosed in US-A-4,568,755, applying a voltage to the conductive brush causes a toner cloud to form above the surface of the activated electrode zone for toner development to occur on a charged image receiver.

US-A-3,996,892 discloses an insulating layer of conductive rubber between 0.025 mm to 0.635 mm (1-25 mils) thick doped with carbon black to coat electrodes on a development roll. This coating reportedly produces a resistivity of 10^7 - 10^9 ohm-cm. Overcoats on electroded rolls provide a resistive layer to protect the electrodes from wear. Overcoats also prevent shorting and breakdown of the device when contacted by, for example, a conductive magnetic brush carrier bead during the toner loading step. Breakdown also can occur during toner charging, metering and development when other AC/DC voltages are applied. Overcoats used for donor devices have been based on conductive particles such as carbon black dispersed in a binder. Desired resistivity is achieved by controlling loading of conductive material. However, very small changes in loading of conductive materials near the percolation threshold cause dramatic changes in resistivity. Also these coatings are often not durable enough and in many cases resistive heating has been observed when electrodes are activated, causing burnout through the coating, shorting and device failure.

Although there are resistive coatings for electrodes of donor devices, there is still a need for improved resistive coatings with greater fabrication latitude and cycling life for electroded donor development devices.

Accordingly, there is provided an electroded donor device and method for preparing same according to the appended claims.

In accordance with the present invention, there is provided an electroded donor device comprising an overcoat comprising charge injection enabling particles and charge transport molecules which can be dispersed in a binder resin. The dielectric overcoat protects the electrodes of the electroded donor device from wear and prevents shorting and breakdown of the donor development system.

The present invention is directed to improved overcoatings for electroded donor devices. The resistive overcoatings on these devices are comprised of charge transport molecules and charge injection enabling particles, which can be dispersed in a binder resin. These resistive overcoatings do not depend on particle to particle contact for charge transport through the overcoat layer, thus reducing the percentage volume of charge injection enabling particles in the overcoat which would otherwise reduce the mechanical strength of the binder. Although there is no intention to limit the present invention to a particular theory, it is believed that when an electric field is generated in the overcoat layer during, for example, an electrode activating step, the charge injection enabling particles are polarized and charges are injected into the transport medium. Injected charges are driven through the overcoat by charging fields where they are eventually neutralized. Space charge in the bulk of the overcoat is thus relaxed by charge emission. Development fields generated during toner loading or image development steps are not sufficiently strong to cause charge redistribution and breakdown in the

electroded donor overcoat.

Toner jumping thresholds in the overcoat range from about 200 to about 1,000 V_{AC} depending on toner loading. These thresholds are the lowest values of AC amplitude which cause toner to be released from the surface of the donor device. The lower the electric field amplitude the more desirable it is as the likelihood of electrical breakdown of the overcoating is reduced. Preferably the toner jumping thresholds range from about 500-800 V_{AC}. Electrical resistivity of the overcoat layer ranges from about 10¹⁰ ohm-cm to about 10¹⁸ ohm-cm, preferably from about 10¹² ohm-cm to about 10¹⁶ ohm-cm. The dielectric strength of the overcoat is high enough such that a conductive magnetic brush with about 500 V can be used to load toner on the overcoat layer without breakdown occurring. The dielectric constant ranges from about 3 to about 12, preferably from about 3 to about 8. Thus the overcoat allows toner loading, charging, metering and development without breakdown occurring when AC/DC voltages are applied to the electroded donor device at the loading and development zones.

Any suitable insulating film forming binder having a high dielectric strength and good electrical insulating properties can be employed in the continuous charge transporting phase of the overcoat of this invention. The binder material can be any material capable of holding charge transport molecules in solid solution or as a molecular dispersion. A solid solution is defined as a composition in which at least one component is dissolved in another component and which exists as a homogeneous solid phase. A molecular dispersion is defined as a composition in which particles of at least one component are dispersed in another component, the dispersion of particles being on a molecular scale.

Typical film forming binder materials (which are not charge transporting materials) suitable for practicing this invention include, but are not limited to, thermoplastic and thermosetting resins such as polycarbonates, polyesters, polyamides, polyurethanes, polystyrenes, polyaryl ethers, polyaryl sulfones, polybutadienes, polysulfones, polyether sulfones, polyethylenes, polypropylenes, polymethyl pentenes, polyphenylene sulfides, polyvinyl acetate, polysiloxanes, polyacrylates, polyvinylacetals, polyimides, amino resins, phenylene oxide resins, terephthalic acid resins, epoxy resins, phenolic resins, polystyrene and acrylonitrile copolymers, polyvinyl chloride, vinyl chloride and vinyl acetate copolymers, acrylate copolymers, alkyd resins, cellulosic film formers, poly(amide-imides), styrenebutadiene copolymers, vinylidenechloride-vinylchloride copolymers, vinylacetate-vinylidenechloride copolymers, styrene-alkyl resins or mixtures thereof and the like as disclosed in US-A-4,515,882, the entire disclosure of which is hereby incorporated herein by reference. The binder material may comprise from about 10% to about 90% by weight of the overcoat layer, preferably from about 25% to about 75% by weight.

Any suitable film forming polymer having charge transport capabilities may be used as a binder in the continuous phase of the overcoat of this invention. The charge transport binder may be a hole transport film forming polymer or an electron transport film forming polymer. Suitable charge transporting film forming polymers include, but are not limited to the following materials and mixtures thereof:

Polyvinylcarbazole and derivatives of Lewis acids described in US-A-4,302,521, the entire disclosure of which is hereby incorporated herein by reference.

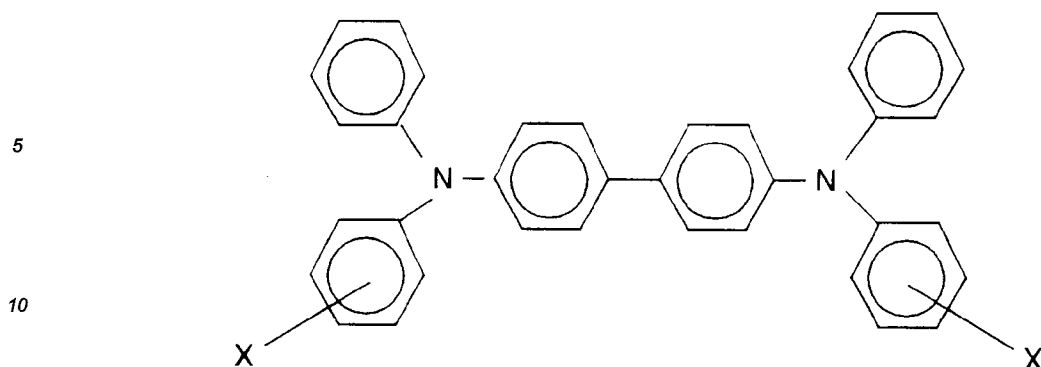
Vinyl-aromatic polymers such as polyvinyl anthracene, polyacenaphthylene; formaldehyde condensation products with various aromatics such as condensates of formaldehyde and 3-bromopyrene; 2,4,7-trinitro-fluorene, and 3,6-dinitro-N-t-butyl-naphthalimide as described in US-A-3,972,717, the entire disclosure of which is hereby incorporated herein by reference.

Other transport materials such as poly-1-vinylpyrene, poly-9-vinylanthracene; poly-9-(4-pentenyl)-carbazole; poly-9-(5-hexyl)-carbazole; polymethylene pyrene; poly-1-(pyrenyl)-butadiene; polymers such as alkyl, nitro, amino, halogen and hydroxy substituted polymers such as poly-3-amino carbazole; 1,3-dibromo-poly-N-vinyl carbazole and 3,6-dibromo-poly-N-vinyl carbazole and numerous other organic polymeric transport materials as described in US-A-3,870,516, the entire disclosure of which is hereby incorporated herein by reference.

Any suitable charge transport molecule capable of acting as a film forming binder or which is soluble or dispersible on a molecular scale in a film forming binder may be utilized in the overcoat of this invention. The charge transport molecule should be capable of transporting charge carriers injected by charge injection enabling particles in an applied electric field. The charge transport molecules may be hole transport molecules or electron transport molecules. Where the charge transport molecule is capable of acting as a film forming binder as indicated above, it may if desired be employed to function as both an insulating binder for the charge injection enabling particles and as the continuous charge transporting phase without the necessity of incorporating a different charge transport molecule in solid solution or as a molecular dispersion therein.

In addition to the polymers having charge transport capabilities listed above, other suitable non-film forming charge transporting materials include, but are not limited to, the following:

Diamine transport molecules include, but are not limited to, compounds having the general formula:



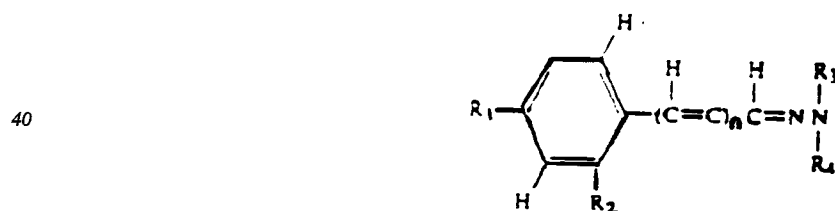
15 wherein X is selected from the group consisting of an alkyl group having from about 4 carbon atoms and chlorine. The compound may be named N,N'-diphenyl-N,N'-bis(alkylphenyl)-[1,1' biphenyl]-4,4'-diamine wherein the alkyl is, for example, methyl, ethyl, propyl, n-butyl, etc. such as N,N'-diphenyl-N,N'-bis(3'-methylphenyl)-[1,1'-biphenyl]-4,4'-diamine, N,N'-diphenyl-N,N'-bis(4-methylphenyl)-[1,1'-biphenyl]-4,4'-diamine, N,N'-diphenyl-N,N'-bis(2-methylphenyl)-[1,1'-biphenyl]-4,4'-diamine, N,N'-diphenyl-N,N'-bis(3-ethylphenyl)-[1,1'-biphenyl]-4,4'-diamine or the compound may be N,N'-diphenyl-N,N'-bis(chloro phenyl)-[1,1'-diphenyl]-4,4'diamine and the like as disclosed in US-A-4,515,882, the entire disclosure of which is hereby incorporated herein by reference.

20 Pyrazoline transport molecules include, but are not limited to, 1-[lepidyl-(2)]-3-(p-diethylaminophenyl)-5-(p-diethylaminophenyl)pyrazoline, 1-[quinolyl-(2)]-3-(p-diethylaminophenyl)-5-(p-diethylaminophenyl)pyrazoline, 1-[pyridyl-(2)]-3-(p-diethylaminostyryl)-5-(p-diethylaminophenyl)pyrazoline, 1-[6-methoxypyridyl-(2)]-3-(p-diethylaminostyryl)-5-(p-diethylaminophenyl)-pyrazoline, 1-phenyl-3-[p-dimethylaminostyryl]-5-(p-dimethylaminostyryl)pyrazoline, 1-phenyl-3-[p-diethylaminostyryl]-5-(p-diethylaminostyryl)pyrazoline, and the like as disclosed in US-A- 4,515,882, the entire disclosure of which is hereby incorporated by reference.

25 Typical fluorene charge transport molecules include, but are not limited to, 9-(4'-dimethylaminobenzylidene)fluorene, 9-(4'-methoxybenzylidene)fluorene, 9-(2',4'-dimethoxybenzylidene)fluorene, 2-nitro-9-benzylidene-fluorene, 2-nitro-9-(4'-diethylaminobenzylidene)fluorene and the like as described in US-A-4,515,882, the entire disclosure of which is hereby incorporated by reference.

30 Oxadiazole transport molecules include, but are not limited to, 2,5-bis(4-diethylaminophenyl)-1,3,4-oxadiazole, pyrazoline, imidazole, triazole and the like as disclosed in US-A-4,5 15,882, the entire disclosure of which is hereby incorporated herein by reference.

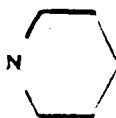
35 Hydrazones as described in US-A-4,515,882 A preferred hydrazone is one having the general formula:



45 $n = 0, 1$
wherein R_1 is



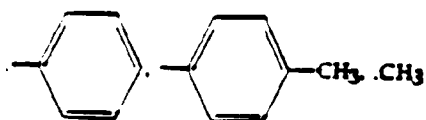
55 $x = 0, 1, 2, 3$ or



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wherein R_2 is OCH_2CH_3 , CH_3 or H.
wherein R_3 is

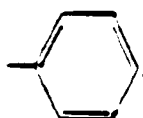
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or $CH_2CH_2CH_2CH_3$, and
wherein R_4 is

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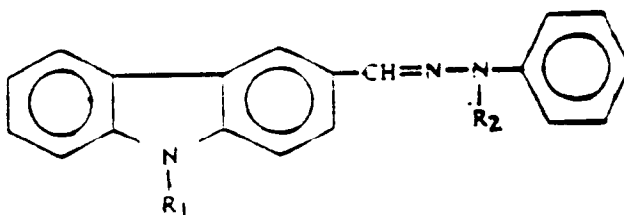
or CH_3 .

Typical examples of hydrazone transport molecules encompassed by this formula include p-diethylaminobenzaldehyde-(diphenylhydrazone), o-ethoxy-p-diethylaminobenzaldehyde-(diphenylhydrazone), o-methyl-p-diethylaminobenzaldehyde-(diphenylhydrazone), p-dipropylaminobenzaldehyde-(diphenylhydrazone), p-diethylaminobenzaldehyde-(benzylphenylhydrazone), p-dibutylaminobenzaldehyde-(diphenylhydrazone), p-dimethylaminobenzaldehyde-(diphenylhydrazone) and the like described, for example in US-A-4,150,987, the entire disclosure of which is hereby incorporated herein by reference. Other hydrazone transport molecules include compounds such as 1-naphthalene-carbaldehyde 1-methyl-1-phenylhydrazone, 1-naphthalenecarbaldehyde 1,1-phenylhydrazone, 4-methoxy-naphthalene-1-carbaldehyde 1-methyl-1-phenylhydrazone and other hydrazone transport molecules described, for example, in US-A-4,385,106; 4,338,388; 4,387,147; 4,399,208; 4,339,207, the entire disclosures of which are hereby incorporated herein by reference.

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Another preferred charge transport molecule is a carbazole phenyl hydrazone having the general formula:

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wherein R_1 represents methyl, ethyl, 2-hydroxyethyl, or 2-chloroethyl group and R_2 represents methyl, ethyl, benzyl or phenyl group.

Typical examples of transport molecules encompassed by this formula include 9-methylcarbazole-3-carbaldehyde-1,1-diphenylhydrazone, 9-ethylcarbazole-3-carbaldehyde-1-methyl-1-phenylhydrazone, 9-ethylcarbazole-3-carbaldehyde-1-ethyl-1-phenylhydrazone, 9-ethylcarbazole-3-carbaldehyde-1-ethyl-1-benzyl-1-phenylhydrazone, 9-ethylcarbazole-3-carbaldehyde-1,1-diphenylhydrazone, and other suitable carbazole phenyl hydrazone transport molecules described, for example, in U.S. Patent No. 4,256,821, the entire disclosure of which is hereby incorporated herein by reference. Similar hydrazone transport molecules are described, for example, in US-A-34,297,426, the entire disclosure of which is hereby incorporated herein by reference.

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Other suitable charge transport molecules described in US-A-4,150,987, 4,256,821 and 3,820,989, can also be employed to practice this invention. The entire disclosures of these references are also hereby incorporated herein by reference.

Other typical transport materials include numerous organic non-polymeric transport materials described in US-A-3,870,516 and non-ionic compounds described in US-A-4,346,157, the entire disclosures of which are hereby incorporated herein by reference.

Other suitable transport materials include, but are not limited to, poly-1-vinylpyrene, poly-9-vinylanthracene, poly-9-(4-pentenyl)-carbazole, poly-9-(5-hexyl)-carbazole, polymethylene pyrene, poly-1-(pyrenyl)-butadiene, polymers such as alkyl, nitro, amino, halogen, and hydroxy substituted polymers such as poly-3-amino carbazole, 1,3-dibromo-poly-N-vinyl carbazole and 3,6-dibromo-poly-N-vinyl carbazole and numerous other transparent organic polymeric or non-polymeric transport materials as described in US-A-3,870,516, the entire disclosure of which is hereby incorporated by reference.

Charge transport molecules are combined with an insulating film forming binder, using ratios of insulating film forming binder:charge transport molecules of about 10 to about 90 parts by weight, preferably from about 25 to about 75 parts by weight. Charge transport molecules comprise from about 10% by weight to about 90% by weight of the overcoat layer, preferably from about 25% to about 75% by weight.

Any suitable organic or inorganic charge injection enabling particles may be utilized in the overcoat layer of this invention. In the organic charge enabling particle embodiments, the particles may comprise phthalocyanine, tetracyanoquinodimethane, polypyrrole, polyacetylene, polyaniline, carbon, graphite, fullerene carbon or mixtures thereof.

In the inorganic charge enabling particle embodiments, the particles may comprise of tin oxide, antimony oxide, titanium oxide, iron oxide, zinc oxide, aluminum oxide, silicon dioxide and mixtures thereof.

Charge injection enabling particles can be hole injection enabling particles or electron injection enabling particles. Any particle can function as a charge injection enabling particle as long as the concentration of the particles and the entire electric field are sufficient to cause the charge injection enabling particles to rapidly polarize and inject charge carriers into the continuous phase of the overcoating layer. Generally, charge injection enabling particles having an electrical resistivity of about 10^{12} ohm-cm or less are suitable. Typical inorganic charge injection enabling particles include, but are not limited to, molybdenum disulfide, silicone, carbon black, graphite, tin oxide, antimony oxide, chromium dioxide, zinc oxide, titanium dioxide, magnesium oxide, manganese dioxide, aluminum oxides, other metal oxides, colloidal silica, colloidal silica treated with silanes, tin, aluminum, nickel, steel, silver, gold, other metals, their oxides, sulfides, halides and other salt forms, and the like, such as disclosed in US-A-5,063,128, 5,063,125 and 4,515,882, the entire disclosures of which are hereby incorporated herein by reference.

Typical examples of organic charge injection enabling particles include, but are not limited to, fluorinated carbon particles; phthalocyanine pigment particles; quinacridone pigment particles; conductive complexes of tetracyanoquinodimethane (TCNQ) with polymeric quaternary ammonium salts, poly(2-vinylpyridene), poly(4-vinylpyridene), poly(N-vinyl imidazole), poly(4-dimethylaminostyrene), and ionene polymers; black brominated poly(cyclopentadiene); polymeric reaction product of poly(alkyl vinyl ketones) with phosphoryl chloride; metal polyphthalocyanines; a tetranitrile formed from tetracyanoethylene solution phase deposited on metal surfaces at about 200°C; the trans isomer of polyacetylene prepared by exposure of acetylene to films of concentrated solutions of a Ziegler-Natta catalyst $[\text{Ti}(\text{OC}_4\text{Hg-n})_4\text{-Al}(\text{C}_2\text{H}_5)_3]$; poly(p-phenylene oxide); polypyrrole formed by the electrolysis of pyrrole; poly(2,5-thienylene); conductive polymers formed by pyrolysis of poly(phenylacetylene), polyynes (pyrolyzed at 200°-600°C), poly(acylacetylene) (pyrolyzed at 400°-870°C), polymeric Schiff Base (pyrolyzed at 500°C), and polyaminoquinone (pyrolyzed at 500°C); $\text{Cu}^{2+}\text{Ni}(\text{S}_2\text{C}_2(\text{CN})_2)_2^{2-}$; copper tetracyanoquinodimethane; potassium tetracyanoquinodimethane; sodium tetracyanoquinodimethane; lithium tetracyanoquinodimethane; complex of anthracene with tetracyanoquinodimethane; complex of pyrene with tetracyanoquinodimethane; polystyrene sulphonic acid with a high degree of sulfonation (Versa-TL 72, available from National Starch and Chemical Corporation); other organic pigment particles; polypyrrole, polyaniline, polyaromatic conducting polymers, polythiothenes as disclosed in US-A-5,063,128; 5,063,125 and 4,515,882, the entire disclosures of which are hereby incorporated herein by reference.

Fullerene carbons, as disclosed in US-A-5,215,841, of which the entire disclosure is hereby incorporated herein by reference, also can be employed as charge injection enabling particles.

Other suitable charge injection enabling species include copper (I) compounds such as cuprous iodide disclosed in US-A-5,120,628 the entire disclosure of which is hereby incorporated herein by reference.

Examples of other charge injection enabling particles are listed in Table I.

TABLE I

Charge Injection Enabling Particles

Compound

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Charge Transfer Salts

Cu TCNQ

K TCNQ

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Li TCNQ

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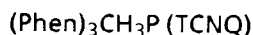
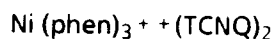
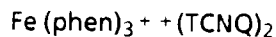
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Complexes

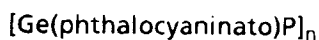
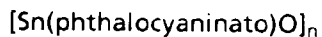
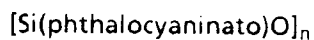


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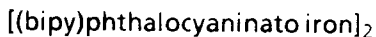


Macrocyclic Compounds (n = 2 to 25)

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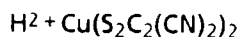
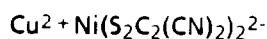


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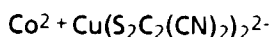
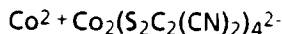
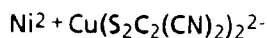


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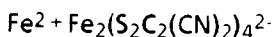
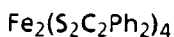
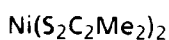
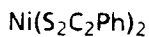
Dithiolene Compounds and Complexes



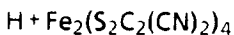
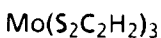
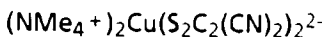
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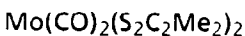
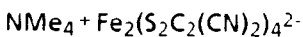
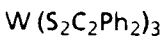
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50 The particle size (volume average particle diameter) of the charge injection enabling particles should be less than about 45 micrometers. A particle size between about 100 Angstroms and about 5000 Angstroms has been found suitable. Generally, the overcoating layer should contain at least about 0.1 percent by weight of the charge injection enabling particles based on the total weight of the overcoating layer. At lower concentrations, a noticeable residual charge tends to form. The upper limit for the amount of the charge injection enabling particles to be used depends upon the relative quantity of charge flow desired through the overcoating layer, the efficiency of the charge injection enabling particles to inject charge and the electric field applied to the overcoating. Satisfactory results have been obtained with the concentrations of charge injection enabling particles as high as 50 percent by weight based on the total weight of the overcoating layer for silica particles, a

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relatively poor charge injection enabling material, dispersed in polycarbonate resin containing dissolved N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl-4,4'-diamine, a charge transport molecule. The concentration of charge injection enabling particles should be considerably less than about 50 percent by weight based on the total weight of the overcoating layer if efficient and high conductive charge injection enabling particles are utilized. For example, the overcoating layer becomes undesirably electrically conductive in an applied field when the silica particles are replaced by a concentration of 50 percent by weight carbon black charge injection enabling particles based on the total weight of the overcoating layer dispersed in polycarbonate resin containing dissolved N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1'-biphenyl-4,4'-diamine.

The components of the overcoat can be mixed together by any suitable means. Typical mixing means include, for example, stirring rods, ultrasonic vibrators, magnetic stirrers, paint shakers, sandmills, roll pebble mills, sonic mixers, melt mixing devices and the like. It is important, however, that if the insulating film forming binder is a different material from the charge transport molecules, the charge transport molecules must either dissolve in the insulating film forming binder or be capable of being molecularly dispersed in the insulating film forming binder. A solvent or solvent mixture for the film forming binder and charge transport molecules may be utilized if desired. Preferably, the solvent or solvent mixture should dissolve both the insulating film forming binder and the charge transport molecules. Examples of suitable solvents include, but are not limited to, methylene chloride, 1,1,2-trichloroethane methylethylketone, toluene, xylene, tetrahydrofuran, and the like.

The overcoating of the present invention can be coated on any suitable electroded donor device. These electroded donor devices may be in the form of a roll, belt, a drum, a pipe, a rod, a scroll or a sheet. Examples of suitable electroded donor devices which can be employed to practice this invention are described in US-A-3,996,892 and US-A-4,568,955, the entire disclosures of which are hereby incorporated herein by reference.

The overcoating of the present invention can be applied to the electroded donor device by any suitable means. Typical techniques for applying an overcoat to a donor device include, for example, spray coating, dip coating, wire wound rod coating, powder coating, electrostatic spraying, sonic spraying, blade coating, web coating, flow extrusion, and the like. If the overcoat is applied by spraying, such spraying may be effected with or without the aid of a gas. Spraying may be assisted by mechanical and/or electrical aids such as in electrostatic spraying. The overcoat should be uniform, smooth and free from blemishes such as entrapped gas bubbles dirt, lint and the like.

Any suitable conventional drying or curing technique employed in the art can be utilized to dry the overcoating. Drying or curing conditions should be selected to avoid damage to the underlying donor device. Typical drying temperatures range from about 20°C to about 150°C, preferably between about 30°C to about 130°C.

The thickness of the overcoat layer after drying or curing may preferably be from about 1 µm to about 50 µm. Generally, overcoat thicknesses of less than about 1 µm fail to provide sufficient protection for the underlying electroded donor device. Greater protection is provided by an overcoat thickness of at least about 3 µm. An overcoat thickness of from about 3 µm to about 15 µm is preferred for optimum protection of the electroded donor device.

Example 1

An overcoat layer is prepared by mixing 0.6 grams of Merlon M39 polycarbonate (available from Miles, Inc., Pittsburg, PA) 0.39 grams of N,N'-diphenyl-N,N'-bis(3-methylphenyl)-[1,1'-biphenyl]-4,4'-diamine prepared as described in U.S. Patent No. 4,265,990 the entire disclosure of which is hereby incorporated herein by reference and 0.01 grams of Black Pearls 2000 carbon black (available from Cabot Corporation, Billerica, MA). The components of the overcoat composition are mixed in methylene chloride in a paint shaker, Red Devil Model No. 5100X, available from Red Devil Inc., Union, N.J., U.S.A. with 3.2 millimeter diameter stainless steel shot for about 90 minutes to form a dispersion. The overcoat composition is applied to axially oriented electrodes on a sheet of polyimide film 0.025 mm (1 mil) thick by means of a Gardner draw bar coater (available from Pacific Scientific) equipped with a coating bar with a 0.050 mm (0.002 inch) gap for depositing a wet film thickness which upon drying yields a coating thickness of about 5 µm. The overcoat is dried at room temperature overnight. The overcoated electroded film is laminated onto an aluminum roll to form the donor roll.

The applicator donor roll is assembled into a magnetic brush development system for an electrostatographic processor for developing latent electrostatic images. The imaging surface is a conventional drum-type xerographic photoreceptor well known in the art.

The overcoating prevents electrical shorting between the electrodes on the donor roll and the conductive magnetic brush used for loading toner on the donor roll. For a .254 Mm (10 mil) gap and AC bias of about 600 volts peak at about 1.5 kHz, uniform solid areas are obtained with an insulative toner and a synchronous speed between the donor roll and image receiver of 10cm/sec. The maximum developed toner M/A (the mass density of toner developed from the donor onto the latent image) is about 0.45 mg/cm² for donor roll loading of about

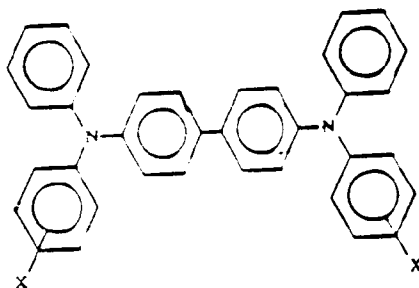
0.50 mg/cm² This yields a development efficiency of about 0.9, i.e., about 90%.

Example 2

5 An overcoat layer is prepared as described in Example 1 above except that 0.6 grams of Lexan 4701 polyphthalate carbonate resin (available from General Electric Co., Pittsfield, MA) is used in place of Merlon M39 polycarbonate. The overcoat is applied to axially oriented electroded material as described in Example 1 to yield a dried overcoating thickness of about 6 μm. The applicator donor roll is assembled into a magnetic brush development system as in Example 1 for developing latent electrostatic images. The overcoating prevents electrical shorting between the electrodes on the donor roll and the conductive magnetic brush used for loading toner on the donor roll for a 0.25 mm (10 mil) gap between the photoreceptor and donor roll and AC bias of about 600 volts peak at 1.5 Khz. Uniform solid areas are obtained with a red toner at a synchronous speed between the donor roll and photoreceptor of about 10.2 cm/sec. The maximum developed mass density of toner from the donor roll onto the latent image is about 0.42 mg/cm² and corresponds to a development efficiency of about 70%. The difference in development efficiency between the overcoating layer of Example 1 and Example 2 is attributed to increased toner adhesion to the polyphthalate carbonate binder of the overcoating layer in Example 2.

20 Claims

1. An electroded donor device, comprising an overcoating comprising charge injection enabling particles and charge transport materials.
- 25 2. A device as claimed in claim 1, wherein the overcoating further comprises binder resin.
3. A device as claimed in claim 2, wherein the binder comprises from about 10 wt. % to about 90 wt. % of the overcoating.
- 30 4. The device of claim 1, wherein the charge injection enabling particles are organic or inorganic.
5. A device as claimed in any one of claims 1 to 4, wherein the charge transport molecules comprise diamine resin, hydrazone, carbazole phenyl hydrazone, oxadiazole or mixtures thereof.
- 35 6. A device as claimed in claim 5, wherein the diamine comprises a compound having the general formula:



wherein X is selected from the group consisting of an alkyl group having from 1 to about 4 carbon atoms and chlorine

- 50 7. A device as claimed in any one of claims 1 to 6, wherein the charge injection enabling particles comprise at least about 0.1 wt. % of the overcoating.
8. A device as claimed in claim 1, wherein the charge transport material comprises from about 10 wt % to about 90 wt % of the overcoating.
- 55 9. A device as claimed in any one of claims 1 to 8, wherein electrical resistivity of the overcoating is at least about 10¹⁰ ohms-cm.

10. A device as claimed in any one of claims 1 to 9, wherein the overcoating has a dielectric constant of from about 3 to about 12.
- 5 11. A device as claimed in any one of claims 1 to 10, wherein the overcoating has a toner jumping threshold of from about 200 to about 1,000 V_{AC}.
12. A device as claimed in any one of claims 1 to 10, wherein the overcoating has a thickness of about 1 μm to about 50 μm, or has a thickness of about 3 μm to about 15 μm
- 10 13. A method for preparing an electroded donor device, comprising forming a mixture of charge injection enabling particles with a charge transport material and applying the mixture to electrodes of the electroded donor device to form an overcoating.
14. An electroded donor device, comprising an electrode and an overcoating comprising from about 10 wt.% to about 90 wt.% of a binder resin, 0.1 wt.% of organic charge injection enabling particles or charge injection particles comprised of metal particles and 10 wt.% to about 90 wt.% of charge transport materials, wherein the overcoating has an electrical resistivity of at least about 10¹⁰ ohms, a dielectric constant of from about 3 to about 12, a toner jumping threshold of from about 200 to about 1,000 V_{ac} and coats the electrode.
- 15 20 15. A method of transferring developer-toner to an imaging member comprising,
transferring developer-toner from a magnetic brush development device under the influence of a magnetic field to an electroded donor device as the electroded donor device passes a nip region of the magnetic brush development system, the electroded donor device being defined by any one of claims 1 to 13.
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