include, but are not limited to, glass, plastic, semiconductor materials, silicon, ceramics, and circuit board materials. Of course it is necessary to provide a light-transparent top electrode.

[0045] Anode

[0046] When EL emission is viewed through anode **103**, the anode should be transparent or substantially transparent to the emission of interest. Common transparent anode materials used in this invention are indium-tin oxide (ITO), indium-zinc oxide (IZO) and tin oxide, but other metal oxides can work including, but not limited to, aluminum- or indium-doped zinc oxide, magnesium-indium oxide, and nickel-tungsten oxide. In addition to these oxides, metal nitrides, such as gallium nitride, and metal selenides, such as zinc selenide, and metal sulfides, such as zinc sulfide, can be used as the anode. For applications where EL emission is viewed only through the cathode electrode, the transmissive characteristics of anode are immaterial and any conductive material can be used, transparent, opaque or reflective. Example conductors for this application include, but are not limited to, gold, iridium, molybdenum, palladium, and platinum. Typical anode materials, transmissive or otherwise, have a work function of 4.1 eV or greater. Desired anode materials are commonly deposited by any suitable means such as evaporation, sputtering, chemical vapor deposition, or electrochemical means. Anodes can be patterned using well-known photolithographic processes. Optionally, anodes may be polished prior to application of other layers to reduce surface roughness so as to minimize shorts or enhance reflectivity.

[0047] Hole-Injecting Layer (HIL)

[0048] While not always necessary, it is often useful to provide a hole-injecting layer **105** between anode **103** and hole-transporting layer **107**. The hole-injecting material can serve to improve the film formation property of subsequent organic layers and to facilitate injection of holes into the hole-transporting layer. Suitable materials for use in the hole-injecting layer include, but are not limited to, porphyrinic compounds as described in U.S. Pat. No. 4,720,432, plasma-deposited fluorocarbon polymers as described in U.S. Pat. No. 6,208,075, and some aromatic amines, for example, m-MTDATA (4,4',4"-tris[(3-methylphenyl)phenylamino]triphenylamine). Alternative hole-injecting materials reportedly useful in organic EL devices are described in EP 0 891 121 A1 and EP 1 029 909A1.

[0049] Hole-Transporting Layer (HTL)

[0050] The hole-transporting layer **107** contains at least one hole-transporting compound such as an aromatic tertiary amine, where the latter is understood to be a compound containing at least one trivalent nitrogen atom that is bonded only to carbon atoms, at least one of which is a member of an aromatic ring. In one form the aromatic tertiary amine can be an arylamine, such as a monoarylamine, diarylamine, triarylamine, or a polymeric arylamine. Exemplary monomeric triarylamines are illustrated by Klupfel et al. U.S. Pat. No. 3,180,730. Other suitable triarylamines substituted with one or more vinyl radicals and/or comprising at least one active hydrogen containing group are disclosed by Brantley et al U.S. Pat. No. 3,567,450 and 3,658,520.

[0051] A more preferred class of aromatic tertiary amines are those which include at least two aromatic tertiary amine moieties as described in U.S. Pat. No. 4,720,432 and 5,061,569. The hole-transporting layer can be formed of a single or a mixture of aromatic tertiary amine compounds. Illustrative of useful aromatic tertiary amines are the following:

[0052] 1,1-Bis(4-di-p-tolylaminophenyl)cyclohexane

[0053] 1,1-Bis(4-di-p-tolylaminophenyl)-4-phenylcyclohexane

[0054] 4,4'-Bis(diphenylamino)quadriphenyl

[0055] Bis(4-dimethylamino-2-methylphenyl)-phenylmethane

[0056] N,N,N-Tri(p-tolyl)amine

[0057] 4-(di-p-tolylamino)-**4'**-[4(di-p-tolylamino)-styryl]stilbene

[0058] N,N,N',N'-Tetra-p-tolyl-4-4'-diaminobiphenyl

[0059] N,N,N',N'-Tetraphenyl-4,4'-diaminobiphenyl

[0060] N,N,N',N'-tetra-1-naphthyl-4,4'-diaminobiphenyl

[0061] N,N,N',N'-tetra-2-naphthyl-4,4'-diaminobiphenyl

[0062] N-Phenylcarbazole

[0063] 4,4'-Bis[N-(1-naphthyl)-N-phenylamino]biphenyl

[0064] 4,4'-Bis[N-(1-naphthyl)-N-(2-naphthyl)amino]biphenyl

[0065] 4,4"-Bis[N-(1-naphthyl)-N-phenylamino]p-terphenyl

[0066] 4,4'-Bis[N-(2-naphthyl)-N-phenylamino]biphenyl

[0067] 4,4'-Bis[N-(3-acenaphthenyl)-N-phenylamino]biphenyl

[0068] 1,5-Bis[N-(1-naphthyl)-N-phenylamino] naphthalene

[0069] 4,4'-Bis[N-(9-anthryl)-N-phenylamino]biphenyl

[0070] 4,4"-Bis[N-(1-anthryl)-N-phenylamino]-p-terphenyl

[0071] 4,4'-Bis[N-(2-phenanthryl)-N-phenylamino] biphenyl

[0072] 4,4'-Bis[N-(8-fluoranthenyl)-N-phenylamino] biphenyl

[0073] 4,4'-Bis[N-(2-pyrenyl)-N-phenylamino]biphenyl

[0074] 4,4'-Bis[N-(2-naphthacenyl)-N-phenylamino] biphenyl

[0075] 4,4'-Bis[N-(2-perylenyl)-N-phenylamino]biphenyl

[0076] 4,4'-Bis[N-(1-coronenyl)-N-phenylamino]biphenyl

[0077] 2,6-Bis(di-p-tolylamino)naphthalene

[0078] 2,6-Bis[di-(1-naphthyl)amino]naphthalene