

[0253] FIG. 24A shows the light transmission measurements of Samples 1-6 before the H₂S treatment and 24 hours after the H₂S treatment. For purpose of comparison, the decrease of light transmission for each sample is also graphed. Prior to the H₂S treatment, all of the samples were shown to be optically clear (having a light transmission higher than 80%). Following 24 hours of the H₂S treatment, all of the samples have experienced decreases in their light transmissions due to different degrees of silver tarnish.

[0254] As expected, Sample 1 had the most reduction in light transmission. Samples 3 and 6 did not perform better than the matrix-only sample (Sample 2). Samples 4 and 5, however, had less reduction in light transmission compared to the matrix-only sample, indicating the corrosion inhibitor dithiothiadiazole was effective in protecting the silver nanowires from being corroded.

[0255] FIG. 24B shows the resistance measurements of Samples 1-6 before the H₂S treatment and 24 hours after the H₂S treatment. For purpose of comparison, the decrease of the resistance for each sample is also graphed. As shown, all but Sample 4 experienced dramatic increases in their resistances and effectively became non-conductive, although the onset of the degradation in electrical properties was significantly delayed for some samples. Sample 4 had only a modest increase in its resistance. It is noted that the impacts of H₂S on Sample 4 and Sample 5 differed considerably, despite that both Samples had the same corrosion inhibitor (dithiothiadiazole). This implies that the coating processes may affect the effectiveness of a given corrosion inhibitor.

[0256] FIG. 24C shows the haze measurements of Samples 1-6 before the H₂S treatment and 24 hours after the H₂S treatment. For purpose of comparison, the change in the haze for each sample is also graphed. All the samples showed increases in their haze measurements. With the exception of Samples 1 and 6, the haze was within acceptable range (less than 10%) for each of Samples 2-5.

[0257] Sample 4 was shown to have the best overall performance in withstanding the corrosive H₂S gas. By incorporating the corrosion inhibitor (dithiothiadiazole) in the matrix, the transparent conductor showed clear advantage over Sample 2 in which no corrosion inhibitor was present.

[0258] It is noted that the H₂S levels in these accelerated tests were far greater than the atmospheric H₂S. It is therefore expected that transparent conductors prepared similarly as Sample 4 would fare even better in the presence of the atmospheric H₂S.

Example 5

Pressure-Treatment of Metal Nanowire Network Layers

[0259] Table 2 illustrates the results of two trials of applying pressure to a surface of a silver nanowire network layer (or "network layer") on a substrate.

[0260] Specifically, silver nanowires of around 70 nm to 80 nm in width and around 8 μm in length were deposited on an Autoflex EBG5 PET substrate. The substrate was treated with Argon plasma prior to the deposition of the nanowires. A network layer was formed according to the method described in Example 2. No matrix material was applied to the networks prior to the pressure treatment. The Trials listed in Table 2 were carried out using a single stainless steel roller on a rigid bench-top surface. The area of the network layer treated was from 3 to 4 inches wide and from 3 to 4 inches long.

TABLE 2

Process	Trial 1 R (Ω/square)	Trial 2 R (Ω/square)	Transmission (%)	Haze (%)
(original)	16000	400000	88.2	3.34
1 roll @ 340 psi	297	690	87.3	3.67
1 roll @ 340 psi	108	230	87.2	4.13
1 roll @ 340 psi	73	127	86.6	4.19
1 roll @ 340 psi	61	92	87.1	4.47
1 roll @ 340 psi	53	86	86.6	4.44
Ar plasma	38	62	88.0	4.19

[0261] Prior to any application of pressure, the network layers had the resistance indicated in the "original" row (the network layers were not pre-treated with plasma.) Each row of Table 2 indicates a subsequent single roll across the network layer at approximately 340 psi.

[0262] In each trial, the network layer was rolled 5 times. Thereafter, a plasma treatment was applied to the network layer. The resistance after each roll is as listed in the second (first trial) and third (second trial) columns. Variation in transmission and haze for the second trial is as listed in the fourth and fifth columns, respectively. As shown, it was determined that the conductivity of the network layer of each trial was increased by application of pressure to a surface thereof.

[0263] As shown above in Table 2, application of pressure to a network layer by a roller can reduce the light transmission of the layer and increase the haze. As shown in Table 3 below, a washing process following the pressure treatment can further improve the transmission and reduce the haze of the network layer.

TABLE 3

Process	Resistance (Ω/□)	Transmission (%)	Haze (%)
(original)	700,000	86.4	4.77
2 rolls @ 340 psi	109	85.6	5.24
soap & water wash	44	86.0	4.94
Ar plasma	24	85.9	4.81

[0264] As shown in Table 3, application of pressure to a network layer by twice rolling with a single stainless steel bar at approximately 340 psi on a rigid surface reduced the light transmission and increased the haze of the network layer. Washing the network layer with soap and water after the rolling, however, increased the transmission and decreased the haze. An argon plasma treatment further improved the transmission and haze.

[0265] Washing the network with soap and water without rolling is also effective at improving the conductivity to some extent.

[0266] Following the pressure or washing treatments, a matrix material can be coated as previously described in Example 2.

Example 6

Photo-Patterning of Conductive Layers

[0267] FIG. 25A illustrates one method of directly patterning a nanowire-based transparent conductive film. In this example, a silver nanowire network layer ("network layer") **600** was initially formed on a glass substrate **604** according to the method described in Example 2. Two holders **610** were placed on the glass substrate **604** to define an area **614** for