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Graphene oxide/silver nanowires hybrid films as potential materials for TCFs

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Transparent conductive films (TCFs) are vital components in electronic devices such as solar cells, touch screens and displays. Indium tin oxide (ITO) is the most used material in this kind of material. However, its advantages include scarcity, high manufacturing cost and mechanical brittleness. In the search for alternatives to ITO, silver nanowires (AgNWs) and graphene oxide (GO) have emerged as promising candidates due to their great optical and electrical properties. The properties of AgNWs, in particular, are intricately linked with their morphology and aspect ratio. AgNWs were synthesized using the polyol method, with ethylene glycol (EG) serving as both solvent and reducing agent, silver nitrate (AgNO3) as the metallic precursor and polyvinylpyrrolidone (PVP) as the capping agent. The obtained AgNWs were purified by centrifugation before being applied on a glass substrate by drop-casting, a simple and cost-effective method. To further enhance the properties of AgNWs films, graphene derivatives have been investigated as a coating layer. Additionally, graphene serves as a protective layer against oxidation. Graphene oxide (GO) was chosen due to its solubility and ease of application via solution processes. GO was synthesized using a modified Hummers method and deposited onto the AgNW film also via drop-casting. Morphological analysis was conducted using scanning electron microscopy (SEM) and atomic force microscopy (AFM). By SEM analysis, GO/AgNWs hybrid films could be observed, showing long and thin wires and wrinkles. A comparison between GO film and GO/AgNW hybrid film was observed by AFM and the topography observed suggest the presence of both materials. The roughness of the hybrid film (rms=23.3 nm) was slightly higher than that GO film (rms=18.6 nm), but significantly lower than that of a pristine AgNW film (rms=40.2 nm). The transmittance spectra showed a maximum at 93.5% for AgNWs films, which decreased to 89.5% at 550 nm with addition of GO. Based on these findings, the hybrid GO/AgNWs films demonstrate optical and morphological characteristics consistent with TCFs.