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Hybrid TCO coatings for flexible display devices

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The development of flexible substrates that are based on polymer films is of critical importance to display and photovoltaic applications. Flexible substrates offer the advantages of mechanical flexibility, design freedom, optical transparency, lightweight, and cost-effectiveness. A number of inorganic functional coatings on polymers have critical properties such as water impermeability and electronic conductance, which are required for display and photovoltaic applications.

In this study high quality transparent conductive films which had the structures of Ag nano wires dispersed thin film and very thin IZO and ITO were coated on a flexible. We control the diameter and length of Ag nano wire and then IZO and ITO coating conditions for increasing the optical, electrical and mechanical properties.

The advanced hybrid TCO films were deposited at RT with a resistivity of $1.5\times10^{-4}\Omega$cm and the transparency of batter than 90% as shown. Change of electrical and optical properties according to the inter layers and plasma conditions was also observed with XRD, TEM, and XPS. TCO films deposited at RT showed nanocrystalline phases evolved on An nano wire surfaces. Very flat surface roughness could be obtained at RT, while surface roughness of the films was increased with increasing the Ag nano wire coating thickness.

The mechanical failure of brittle oxide and TCO coatings on flexible polymers is the one of a key issue. The formation of defects, such as cracks and debonding in TCO films may be inevitable in situations in which bend geometries are required, because of the large difference between the elastic properties of TCO and polymers. The initiation and subsequent developments of defects mainly depend on the coating material, thickness, and interfacial adhesion. Thus, it is important to have a clear understanding of the failure behavior of coatings in the case of bend geometries, in order to prevent the destruction of devices in which they are used. Flexibility of hybrid TCO films was measured as functions of the bending radius and bending cycle in bend geometries and then shown an excellent flexibility. It will be considered that these experimental results can be applied to the TCO substrate of flexible display devices.