Indium Oxide and Indium-Tin Oxide (ITO) Coatings

APPLICATION NOTE

General Properties

When applied as a coating to glass, mylar, or other transparent surfaces, **indium oxide** and **indium-tin oxide (ITO)** create conductive, highly transparent surfaces, which reflect infrared rays while allowing visible light and ultraviolet rays to pass.

Oxide-coated glass meets a wide range of demanding environmental requirements, due in part to the superior hardness and durability of the coatings.

While oxide coatings can be readily etched, they are resistant to most commercial solvents such as xylene, naptha, acetone, methyl ethyl ketone, toluene, and mineral spirits. However, oxide coatings are soluble in dilute mineral acids.

Applications

Indium oxide and ITO coatings are used in a wide variety of applications such as solar collector panels, photovoltaic cells, low-E residential and commercial windows, liquid crystal display glass, aircraft windshields, highly efficient low pressure sodium lamps, and transparent antistatic panels.

Limitations

Oxide-coatings are not recommended for prolonged exposure to temperatures greater than 300°F, or 150°C in oxygen or air atmospheres, which may result in undesired changes in resistivity.

Coating Methods

Several methods for obtaining thin films of ITO or In_2O_3 include gas phase hydrolysis, sputtering, and chemical vapor deposition.

ITO Technical Data

- **Electrical Resistivity:** Most ITO coated glass is available in surface resistivities from 5 ohms/square to 1000 ohms/square.
- **Temperature Coefficient of Resistance:** For an average 50 ohms/square surface resistivity, the temperature coefficient of resistance is about $+2 \times 10^{-4}$ per °C(F).
- **Service Temperatures:** Generally, ITO coatings are stable up to 150°C (300°F). Surface resistivity increases about 10% following exposure to 400°F for one hour. The rate increase accelerates at higher temperatures.
- **Refractive Index:**
  - Substrate glass – 1.52
  - ITO-coated Glass – 2.0
- **Transmittance and Reflectance:** Visible transmittance of ITO-coated glass is from 75 to 90% for glass substrate thicknesses ranging from 0.5mm to 6.0mm. Typical reflectance measurements range from 8 to 25%.
- **Materials Available:** While Indium Corporation is not engaged in the actual application of coatings to substrates, a wide variety of indium-bearing materials are available for rapid delivery. These materials include indium oxide; indium-tin oxide; pure indium metal; and indium, tin, and alloys for chemical vapor deposition.

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