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DEPO / Plasma - deposited coatings for optical, electronical and other functionalities

Deterioration mechanism of RF-sputtered ITO films on plastic substrates

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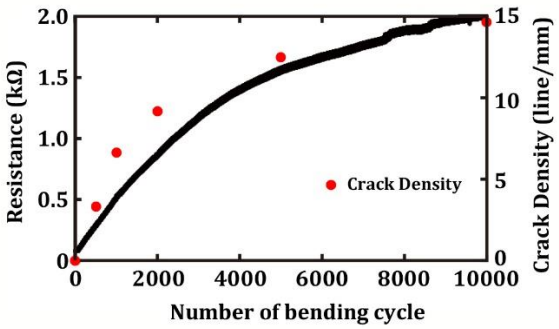
Abstract content

Forming thin films on flexible substrates such as polymer films is an important technical issue for manufacturing portable electronic devices. In particular, transparent conductive films such as indium tin oxide (ITO) on flexible substrates are essential for the development of future portable display devices that can be bent while maintaining low resistance and high optical transmittance. However, research on the durability of such flexible transparent conductive films is still in its infancy, and there are many problems to be elucidated about the mechanism of deterioration of electrical properties. Using the RF magnetron sputtering method, we formed ITO films on PEN (polyethylene naphthalate, Theonex) substrates at room temperature to produce low resistance thin films (typically $3.8 \times 10^{-4} \Omega$ cm). This is about the same resistivity as that formed on glass substrates at high temperatures. Furthermore, we have developed a device that can measure resistance changes in realtime while bending the film inward and outward by ± 90°, and conducted 10,000 bending tests. A typical example of resistance changes during bending cycles with a bend radius R = 10 mm is shown in Fig. 1. It can be seen that as the number of bending cycle increases, the resistance of the ITO film increases accordingly. Examination with optical microscopy revealed an increase in the number of cracks perpendicular to the bending direction. The increase in crack density and resistivity showed a good correlation. We have found that bending the ITO film inward or outward reduces or increases resistance with each bend. Hall measurements in curved samples exhibited that bending changes both mobility and carrier density, as shown in Fig. 2.

References

Resistance change by bending cycle



Carrier Density and Mobility change by bending