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## Multifunctional Indium Tin Oxide Thin Films

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We present multifunctional indium tin oxide (ITO) thin films formed at room temperature by a normal sputtering system equipped with a plasma limiter which effectively blocks the bombardment of energetic negative oxygen ions (NOIs). The ITO thin film possesses not only low resistivity but also high gas diffusion barrier properties even though it is deposited on a plastic substrate at room temperature without post annealing. Argon neutrals incident to substrates in the sputtering have an optimal energy window from 20 to 30 eV under the condition of blocking energetic NOIs to form ITO nano-crystalline structure. The effect of blocking energetic NOIs and argon neutrals with optimal energy make the resistivity decrease to  $3.61 \times 10^{-4} \Omega\text{cm}$  and the water vapor transmission rate (WVTR) of 100 nm thick ITO film drop to  $3.9 \times 10^{-3} \text{ g}/(\text{m}^2\text{day})$  under environmental conditions of 90% relative humidity and 50°C, which corresponds to a value of  $\sim 10^{-5} \text{ g}/(\text{m}^2\text{day})$  at room temperature and air conditions. The multifunctional ITO thin films with low resistivity and low gas permeability will be highly valuable for plastic electronics applications.

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