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Relationship between surface chemistry and work function of indium tin oxide films modified by low energy ion irradiation

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Changes of surface compositions and work functions of indium tin oxide (ITO) films were investigated by x-ray photoelectron spectroscopy (XPS) and ultraviolet photoelectron spectroscopy (UPS) after Ar^+ and O_2^+ ion irradiation and over-deposition of oxygen-rich resistive layer. Ion beam energy of ion irradiation was 1 keV and ion dose changed from 1×10^{15} ions/cm^2 to 1×10^{17} ions/cm^2. Oxygen-rich resistive layer was deposited in an ion beam sputter system with Ar : O_2 flow ratio of 1 : 0.5. All manipulations induced the increase of ITO work function in the different degree and oxygen ion irradiation was most effective for the increase of work function. The increase of work function was 0.3 eV and 0.95 eV in cases of Ar^+ irradiation and in O_2^+ irradiation respectively. In case of depositing resistive layer, work function increased to 0.72 eV compared to as-received ITO films. By XPS composition analysis, the increase of work function may be induced from the decrease of oxygen vacancies and Sn dopant in ITO film. However, the effect of carbon contaminants on ITO work function commented in previous studies[1,2] was not clear. The detailed explanation on the effect of relative ratio of O/In on ITO work function will be given.

[Reference]

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