Grown of nano-silver structures to improve AZO layer by RF magnetron sputtering

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Abstract

In this study, the nano-silver structures was grown to improve AZO layer by RF magnetron sputtering. The best figure of merit is $0.136 \times 10^{-2} (\Omega^{-1})$ in the thickness nano-Ag is 8nm, which means the highest transmittance is 81.4% and the lower resistivity is $4.113 \times 10^{-4} \Omega$-cm. AZO is a well known high transparent conducting material with high electron carrier density($>~10^{20}/\text{cm}^3$) which is attributed to the presence of intrinsic defects, such as oxygen vacancies a Zn interstitials. The zinc oxide(ZnO) thin film is a wide band gap (3.2eV) semiconductor material with high transmittance over the visible region. The ZnO thin film also has lower cost, abundant, and non-toxic. However, the ZnO thin film has poor electrical conductivity, instead of the aluminum-doped ZnO(AZO) has excellent electrical properties. It had been reported when a metal mirror layer was embedded within the dielectric thin film[1], which could suppress the reflection from the metal in the visible range and achieve a selective transparent effect. In this study, we designed a nano-Ag/AZO structures, the intermediate nano-Ag layer was controlled in different thickness by RF magnetron sputtering. The surface morphologys before cover AZO layer deposited were observed in different Ag thickness by FE-SEM as shown in Figure, it was found that the nano-Ag structure with 8 nm thickness has more uniform distribution. The un-regular structures were obviously observed in the thickness of 10 nm and 12 nm, which mean the increasing Ag thickness will induce the segregation of silver, and perhaps to form more scattering effect.


Figure. The FE-SEM image of the various Ag thickness as 8nm, 10nm and 12nm.