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Transparent and conductive properties of Nb doped TiO2 films prepared by magnetron sputtering

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Nb doped TiO_2 (NTO) thin films have been popular studied because of the significant potential to instead Indium Tin Oxide (ITO) as a Transparent Conducting Oxide. However, both transparent and conductive NTO can only be prepared on costly sapphire substrate. The scalable and commercialization is difficult. In this study, NTO thin films with various thicknesses from 250 to 400 nm are fabricated on cheap soda-lime glass substrates by direct current magnetron sputtering. By the next two-step annealing in the Ar gas with 5at. % H_2 at 400℃, both the conductivity and transmittance in the visible region are improved greatly. The relationships between structure, morphology and optical and electrical properties of the prepared films are studied. An amorphous NTO structure after sputtering and anatase (101) and (004) after annealing is indispensable and rutile (210) should be avoided in the annealing. By optimize the thicknesses of the NTO films, the resistivity can be decreased to 7.44×10^{-4} Ω·cm for the thickness of 350 nm. The average transmittance in the visible region increases monotonically with the decrease of thickness due to the reduction of optical absorption. The best average transmittance in the visible range reaches 81% for the thickness of 250 nm.

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