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A new conductive material for energy efficient window applications

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Silver-based and TiN based thin film glass coatings with thicknesses of tens of nanometers are widely used in today's energy-efficient building windows. However, there is no Ag-Ti alloy thin film coating on optical coating applications reported. In this study, Ag-Ti alloy from 10nm to 40nm thin film was deposited by a co-sputter technique at a magnetron sputter system with three sputtering target guns in a high vacuum chamber. The chamber base pressure is 4×10^{-7} Torr, and the films were deposited at 3 mTorr. The Ag to Ti ratio in AgTi alloy was controlled by the two independent pulsed-DC power suppliers, from 50W to 200W during the sputtering deposition. The Ag-Ti alloy single thin film refractive index (n,k) were measured by a Woollam ellipsometer combined with a Shimadzu 3700 UV-Vis-NIR spectrometer (300nm to 2500nm), and the optical properties of the new nanoscale thin film materials Ag-Ti alloys are the first time reported. The alloy Ag-Ti refractive index was strongly dependent on its resistivity, which was calculated from the resistance measured by a four-point probe and the film thickness measured by the ellipsometer. The third target in the chamber is Si target, which is used for the thin film Si_3N_4 deposition by reactive sputtering Si target under Ar-N_2 mixed gas at 3 mTorr. The thin film stack of $\text{Si}_3\text{N}_4/\text{Ag-Ti}/\text{Si}_3\text{N}_4$ on glass was simulated for the optical performance optimization to guide the experiments, and the transmittance of (40 nm Si_3N_4 / 20 nm Ag-Ti / 12 nm Si_3N_4 / glass) on glass could be 40%~50%, and those performances are comparable to many energy efficient window products on the market today, on the other hand, such a tri-layer simple stack showed the potential benefits of lower production costs.

Biography

Xiyue Zhou and Yucen Liu are students at De Anza College, California, USA. They used a modern nano-thin film deposition research system to study new conductive materials, and characterized the optical properties of these new materials, which were the first reported, and could be used other optical applications; under the guidance of Dr. Ding, they used these new materials to develop new energy-efficient windows prototype products.

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