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Simulations and experiments on Ag-Ti alloy optical properties and its window coating application

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Abstract :

Modern materials simulation and optical coating simulation provide an efficient way to accelerate the R&D of optical coating, such as energy efficient window coating development. Silver or tin based thin film coatings are commonly used in today's energy-efficient window coating; however, no Ag-Ti alloy optical properties and their optical coating applications are yet reported. In this study, the optical properties of Ag-Ti alloy were first simulated through the Bruggeman model, then thin film Ag-Ti alloys were experimentally deposited by a co-sputter technique at a magnetron sputter system under 3 mTorr condition. The system vacuum base pressure was 4$\blacklozenge$?$\blacklozenge$?10-7 Torr. The two independent pulsed-DC power suppliers can easily control the Ag to Ti ratio during the Ag-Ti alloy deposition, from 50 W to 200 W with a duty cycle of 80%. The thin film refractive indices (n, k) of the Ag-Ti alloys were measured by a Woollam spectroscopic ellipsometer and a Shimadzu 3700 UVVis-NIR spectrometer (300 nm to 2500 nm), thus the spectroscopic optical properties of the Ag-Ti alloys can be reported for the first time. There were three magnetron guns in the chamber and Si target was installed in the third gun. The thin film Si3N4 was deposited at 3 mTorr by reactive sputtering Si target under Ar-N2 mixed gas. The simulation for the optical performance optimization on the thin film stack of Si3N4/Ag-Ti/Si3N4/glass was carried out to guide the experiments, and the transmittance of the stack (45 nm Si3N4/20 nm Ag-Ti/45 nm Si3N4/glass) could be ~50%, which was comparable to many window coating products in the market. The higher the Ag content in Ag-Ti alloy, the smaller the refractive index n at 550 nm of the alloy, the higher the transmittance of the stack could be achieved.

Biography :

Guowen Ding technically led a research group on energy saving glass coating research in the past 6 years, biweekly generated a patent alert in the past 3 years. Mr. Thomas Lu is a high school student at Gunn High School set to graduate in 2018 and studied the optical thin film simulation and experiments for the energy efficient window applications under Dr. Guowen Ding.

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