POSTER

PEALD SiO2/TiO2 Anti-Reflective Coatings for Enhanced Optical Efficiency in Image Sensors

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Anti-reflective coatings (ARCs) are critical for image sensors, where minimizing reflection losses directly improves light collection efficiency and overall device performance. Plasma-enhanced atomic layer deposition (PEALD) SiO_2 and TiO_2 thin films were investigated as building blocks for such ARCs. Both materials exhibited a pronounced thickness dependence of the refractive index, with distinct underlying mechanisms. SiO_2 films showed a progressive increase in refractive index attributed to densification of the amorphous network, confirmed by X-ray diffraction (XRD) and X-ray Photoelectron Spectroscopy (XPS), while TiO_2 films exhibited a two-step increase correlated with a thickness-induced amorphous-to-anatase transition above approximately 20 nm.

Using the experimentally determined optical constants as a function of thickness, multilayer ARC structures were simulated with *OpenFilters* to minimize reflectance over the visible range (400–780 nm). An idealized 8-layer design, assuming constant bulk-like refractive indices, achieved a mean reflectance of 0.07%. Incorporating the experimentally observed thickness-dependent evolution of the refractive index into the optical model yielded a more realistic 8-layer design with a mean reflectance of 0.27 %, showing that process-specific optical constants, rather than idealized bulk values, are essential for reliable ARC design.

These results establish a structural and chemical basis for the design of PEALD-grown SiO_2/TiO_2 ARC stacks for integration onto image sensor devices.

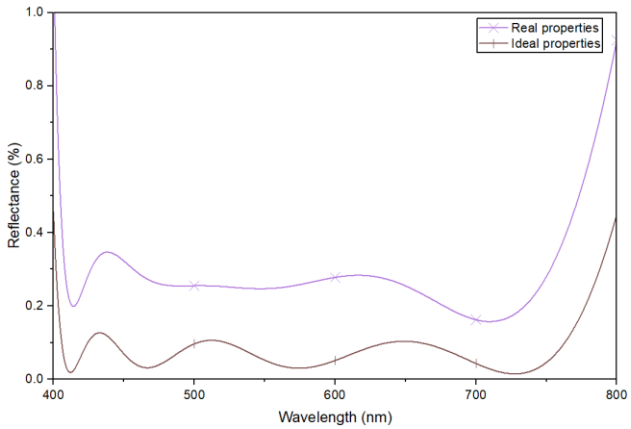


Fig. 1. Simulation of 8-layer ARC using real and ideal optical properties.

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