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Solar Selective Absorbing Characteristics and Thermal Stability of TiAlSiN Coatings

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Owing to their many outstanding properties, TiAlSiN coatings have received significant attention as solar selective absorbers for harvesting solar energy in various applications such as thermal solar collectors, solar steam generators and steam turbines for producing the electricity at mid and mid-to high temperatures [1-3]. Although, transition metal nitride based quaternary TiAlSiN coatings are attractive candidates as protective and decorative coatings for cutting tools etc. In this article, unbalanced magnetron sputtered TiAlSiN thin film coatings were deposited on AISI M2 steel substrate and structural stability, surface morphology and solar selective absorption behaviors investigated at various temperatures. The films were characterized via synchrotron radiation X-ray diffraction (SR-XRD), scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), UV-Vis spectroscopy, and FTIR spectroscopy. SR-XRD studies show the existence of multiple polycrystalline phases with good oxidation resistance behaviors of these coatings. Formations of nanocomposite-like fine grain structures were observed from the SEM micrographs with average grain size 25 nm. The XPS study indicated that increasing the annealing temperature also enhanced the degree of surface oxidation of the coatings. The TiAlSiN coatings showed varying solar selectivity as the annealing temperature increased with a solar selectivity \( s = a/E \) of 24.63 obtained by the coating annealed at 700 °C.