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***Oxidation Behavior of HVSFS Sprayed TiN/Al<sub>2</sub>O<sub>3</sub> Composite Coatings and Its Influence on Coating Properties***

**Abstract:**

Titanium nitride (TiN) is attractive for protective coatings due to its high hardness, wear resistance, and chemical stability. However, under atmospheric conditions, TiN tends to oxidize and degrade before melting, which remains a major challenge for thermal spray processing and can directly influence the resulting coating properties. In this work, TiN/Al<sub>2</sub>O<sub>3</sub> composite coatings were deposited by High Velocity Suspension Flame Spraying (HVSFS) to investigate the oxidation behavior of TiN and its relationship with phase composition, microstructure, and coating properties. Different TiN feedstock particle sizes and HVSFS process conditions were investigated to evaluate their influence on oxidation, phase evolution, microstructure, and hardness. Phase evolution and local chemical composition were analyzed by X-ray diffraction, TEM, EDS, and Raman spectroscopy. In addition, coating microstructure, porosity, and hardness were evaluated, while tribological behavior was investigated for selected coatings produced using coarse TiN feedstock.

The results demonstrate that TiN can be successfully deposited under atmospheric conditions using HVSFS, achieving a homogeneous distribution of TiN particles within the alumina matrix. The results further suggest that oxidation is not solely associated with degradation of the nitride phase, but can be influenced by the HVSFS process conditions. TEM/EDS analysis revealed embedded TiN particles surrounded by TiO<sub>x</sub>N<sub>y</sub> shells. The study provides insight into the oxidation behavior of TiN during HVSFS processing and its relationship with the resulting coating properties.