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| **Title:** | Oxygen concentration – A governing parameter for microstructural tailoring of duplex AlCrSiON coatings for superior mechanical, tribological, and anti-corrosion performance | | |
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| **Abstract:** |  |
| This study investigates the impact of increasing oxygen levels on structure, and mechanical properties and tribological performance of duplex AlCrSiON coatings. AISI H13 steel and tungsten carbide substrates are coated using arc ion plating with increasing oxygen flow rate up to 200 sccm with varying oxygen concentration. High-resolution transmission electron microscopy, scanning electron microscopy, X-ray photoelectron spectroscopy, X-ray diffraction, and three-dimensional profilometer are used to study morphological and structural evolution. Correspondingly, the coatings are assessed for hardness, adhesion strength, friction coefficient, and resistance against corrosion and wear. A 50–100 sccm oxygen flow rate is considered as an optimal range to receive lower surface roughness. Generally, the addition of oxygen has compromised hardness and friction coefficient but improve adhesion strength, wear and corrosion resistance with increasing oxygen concentration. The immersion tests have identified pitting corrosion as a dominating failure mechanism for AlCrSiON coatings when exposed to molten A380 aluminium alloy. This corrosion resistance stems from their dense microstructure, excellent thermal stability, and the presence of fcc-(Al, Cr)2O3 phase structure. This study demonstrates that controlled oxygen concentration is a crucial parameter for tuning the microstructure of AlCrSiON coatings to achieve superior mechanical, tribological, and anti-corrosion performance, particularly for high-pressure die-casting applications. | |