PhD Subject

Thermally sprayed ceramic coatings are widely used in energy, transportation, petrochemical and advanced manufacturing sectors for surface protection against wear, corrosion, erosion and high-temperature degradation. Their practical value lies in the ability to tailor surface properties without changing the bulk material, thereby extending component service life and supporting cost-effective repair.

A thermally sprayed coating is formed by the successive impact, spreading and stacking of molten or semi-molten particles. Its microstructure is therefore inherently lamellar, containing splat boundaries, pores, oxides and partially bonded regions. Among these features, the bonding quality between adjacent particles plays a key role in determining the coating cohesion and strongly influences crack initiation, crack propagation and resistance to surface damage. As a result, interparticle cohesion is one of the most important factors governing the wear and corrosion performance of thermal spray coatings.

However, the intrinsic cohesion of thermally sprayed coatings remains difficult to evaluate. Conventional tensile adhesion tests are commonly used to characterize coating strength, but failure often occurs at the coating/substrate interface or in the adhesive layer, and the measured values are usually limited to only a few tens of MPa. Such methods therefore provide little direct information on the internal bonding state of the coating, especially the cohesion between deposited particles or splats.

Under cavitation conditions, the repeated collapse of bubbles produces highly localized impact stresses and micro-jet loading. These transient hammering stresses are particularly sensitive to weakly bonded interparticle interfaces and can preferentially induce crack initiation and propagation along splat boundaries. In this sense, cavitation is not only a degradation mode, but also a potentially effective means of probing the internal cohesion of thermally sprayed coatings. Compared with conventional adhesion testing, cavitation loading interacts more directly with the lamellar structure and internal weak interfaces that control coating failure.

Based on this idea, the present PhD project aims to investigate the relationship between spray processing, interparticle bonding and cavitation response in thermally sprayed ceramic coatings. Reference coatings based on ZrO_2 with different stabilizing materials,

Cr_2O_3 and Al_2O_3 will be deposited using plasma spraying. The effects of material, spray parameters, powder size and powder morphology on coating formation, splat bonding and damage evolution under cavitation loading will be systematically studied. By correlating cavitation behavior with microstructural observations and failure features, this work seeks to clarify the scientific mechanism linking interparticle cohesion to cavitation resistance, and to establish cavitation testing as a relevant approach for evaluating bonding quality within thermal spray coatings.

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Thermal spray Process, Diagnostic on jet and particles, Coating characterizations, IA