Thermal spray is a surface modification technique where solid, semimolten, or molten feedstock powders from metals to ceramics are propelled towards and deposited onto the target surface to form the coating. So far, a variety of thermal spray processes (e.g., HVOF spray, plasma spray, flame spray, wire arc spray, and cold spray) have been developed and widely applied in a broad range of industries including aerospace, automatic, energy, medical, and marine industries. The thermal sprayed coatings provide effective protection against high temperature, corrosion, erosion, oxidation, wear, chemicals, bacteria, and so on. Particularly, certain thermal spray processes can be utilized as an additive manufacturing technique to fabricate standing-free parts or restore damaged components. Given the aforementioned advantages and great potentials, investigations regarding thermal spray processes are always a focal subject and attracting great attentions from both scientific and industrial communities.

This special issue holds 1 review and 9 original research articles. Various thermal spray technologies including cold spray, HVOF spray, arc spray, and plasma spray were used to produce coatings for wear resistance, oxidation resistance, chemical resistance, thermal resistance, and structural applications.

Q. Jia and coworkers reported improved oxidation-resistance properties of arc-sprayed Al coating onto the Ti substrate through modification reaction. Their study focused on the effect of heating temperature and heating time on the Ti-Al diffusion and the consequent Ti-Al intermetallic phase formation. The experimental result demonstrated that thick intermetallic phases including TiAl, TiAl2, and TiAl3 were formed after heating in different conditions. Due to the formation of the intermetallic layers after modification treatment, the Ti substrate with the arc-sprayed Al coatings on the surface had better oxidation-resistance properties in a high-temperature environment than the pure Ti substrate without coating protection.

S. Yin and coworkers contributed a review on nanostructured metal coatings produced with cold spray. They first provided a comprehensive literature review on the nanocrystallization phenomenon occurring in cold-sprayed coatings. Then, the focus was switched to the microstructure and properties of cold-sprayed nanocrystalline metal coatings. They also summarized the current existing studies concerning 1D, 2D, and 3D nanoparticle-reinforced metal matrix composite coatings and their properties. Based on the review, future perspectives of the cold spray technology in producing metal coatings with the nanostructure were proposed at the end of their paper.

D. Fang and coworkers contributed a research paper on the application of robotics and automation in thermal spray processes. They proposed a new method to automatically generate nozzle trajectories for producing uniform coatings on complex curved surfaces. Experimental validation
positively proved the capability and advances of this novel method.

C. De Crescenzo and coworkers proposed a revolutionary technology based on shape memory alloy (SMA) coatings deposited on-site to large-scale metallic structural elements. Investigations were carried out by depositing commercial NiTinol Ni50.8Ti (at.%) powder onto AISI 316L stainless steel substrates using the HVOF thermal spray technology. The main concern of this paper was studying the effect of main processing parameters including spray distance, fuel-to-oxygen feed rate ratio, and coating thickness on the quality and properties of the coating in terms of hardness, adhesion, roughness, and microstructure. The results confirmed that using optimal spray parameters could significantly improve the properties of HVOF Ni-Ti coatings. The HVOF spraying technique could produce oxide-free SMA coatings without changing the chemical composition of the coating material as compared to the original powder feedstock.

L. Fang and coworkers contributed a research article on cold-sprayed Al + SiO₂ metal matrix composite coatings for protecting the underlying AZ31 Mg alloy substrate. They mainly studied the role of SiO₂ reinforcement in the coating property improvement. The experimental result revealed that adding SiO₂ particles in the metallic Al coatings could significantly improve the coating properties including microhardness, adhesion strength, wear resistance, and corrosion resistance. They also found that the content of SiO₂ particles in the coatings had no significant effects on the coating properties. This work proved that the cold-sprayed Al + SiO₂ metal matrix composite coatings could facilitate the structural applications of Mg alloys.

H.-S. Lee and coworkers studied the corrosion-resistance properties of arc-sprayed AISI 304L stainless steel and Ti coatings in pH 4 solution. They reported that the Ti coating exhibited a uniform, less porous, and adherent coating morphology compared to the AISI 304L coating. The potentiodynamic study showed that the Ti coating reduced the corrosion rate by more than six times compared to the AISI 304L coating after 312h of exposure to sulfuric acid (H₂SO₄) contaminated water solution due to the uniform and globular morphology of the passive film formed on the Ti coating.

G.-l. Li and coworkers reported a new method to remelt thick plasma-sprayed self-fluxing NiCrBSi coatings with the tungsten inert gas (TIG) arc technology and to improve the properties of the NiCrBSi coatings. They found that TIG-remelting treatment significantly eliminated the micro-defects in the coatings and improved their density. The main phases in the as-sprayed coating changed from γ-Ni, Cr₁₇C₀, and Cr₇B before remelting treatment to γ-Ni, Crₓ₁₇C₀ₓ, CrB, Ni₃B, and Fe₃C after. The remelted coatings had improved surface roughness, hardness, and wear-resistance properties. The result clearly suggested that the TIG-remelting technique is promising as a post-treatment method to improve the coating properties.

K. Wen and coworkers conducted a research to investigate the thermal and flow dynamics in a plasma torch using the numerical simulation method. The flow regime of a plasma jet determines the acceleration and heating behaviors of powder particles and hence influences the quality of a plasma-sprayed coating. In this study, based on a well-designed transient CFD model, the authors studied a number of key parameters involved in a plasma torch including arc voltage, net power, thermal efficiency, and in-flight particle velocity based on a standard cylindrical plasma nozzle and a cone-shaped plasma nozzle. The modelling result showed that the geometry of a plasma torch significantly affected the thermal and flow regime of a plasma jet, therefore influencing the final coating quality.

In summary, this special issue provides a detailed account of the present status of the thermal spray technology and highlights the recent developments which cover the novel and important aspects of these technologies and their applications.

Conflicts of Interest

The editors declare that there are no conflicts of interest regarding the publication of this editorial.

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