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GUEST EDITORIAL

Developments in Materials for High-Temperature Corrosion and Oxidation

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It is an ongoing challenge for researchers and industries to develop materials for high-temperature applications without compromising inherent metallurgical qualities and other properties. Indeed, there is a demand for high-performance materials to enable extreme efficiency while functioning at an elevated temperature. In addition, the materials often have to face molten salt and hot gases in aggressive environments during the time of system operation. For example, the materials used in aviation engines, power plants, nuclear reactors, and many more chemical process industries are looking for the in situ material to increase the life of the components with higher performance.

In this current scenario, researchers are focusing to develop and process a material by varying the alloying elements and modifying the metallurgical characteristics. In general, nickel-based superalloys are highly recommended for high-temperature applications. These alloys are specially designed and processed to generate a single-crystal structure, though they are vulnerable to degrade under the aggressive environment during prolonged exposure. At elevated temperatures, the major alloying elements in superalloys, such as Ni, Cr, Ti, and Fe, are susceptible to oxidation and, as a result, NiO, Cr_2O_3, TiO_3, and $NiCr_2O_4$ may form over the exposed surface. In terms of strength, the same alloy constituents comprise the matrix γ phase (austenite), and during oxidation there will be a chance for metallurgical transformation in the form of precipitations (γ″, γ′, and δ phases) due to selective reaction processes. In some cases, the presence of aluminium in the alloy will protect the material by aluminium oxide formation.

Application of coatings, such thermal barrier coatings (TBCs), and/or bulk processing techniques, such as plasma surface processing, ageing, solutionising, and other methods are adopted to increase reliability of the material and its performances under different operating environments. Topical research on thermal spray coatings with different combinations of ceramics and metal powders is available for

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the readers in this special issue. Along with ceramic coatings, different reinforcements are used to enrich the mechanical, tribological, and surface properties.

Recently, additive manufacturing has paved way to overcome shortfalls in terms of the industrial requirements stated above. Still the scope on additive manufacturing with high-temperature investigation is open for much more exploration. The gyroid structures and foam model of metal for different operating temperatures are a recent research trend.

From existing literature and reports, unique research on materials development for high-temperature applications is an endless demand. As many papers in this special issue show, optimised alloy compositions are being designed to meet the industrial demands. The outcome of each research findings will bridge the gap and act as steps for young researchers to take as they march towards the successful development of materials for different applications.