In-Situ Transformable NanoScale Coatings For Elevated Temperature Erosion Corrosion Environments

Abstract

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Water wall tubes in coal fired, circulatory fluidized bed, and biomass boilers are commonly coated with a thermal spray material to protect the tubes from erosion, corrosion or complex wear modes which can weaken the tube wall causing premature failure. For erosion and wear protection, the hardness of the thermal spray coating is paramount and very high hardness levels can be achieved in metallic systems through a Bulk Materials Nanotechnology (BMN) approach. This presentation will focus on a new class of glass forming twin wire-arc thermal spray coatings which have been designed to excel in elevated temperature environments involving erosion, wear and corrosion. While the as-sprayed coatings, due to the refined nanoscale structure, are very hard and abrasion resistant, in-situ elevated temperature exposure results in a further and dramatic improvement in hardness, abrasion and erosion resistance. Due to the significance of these beneficial changes in coating behavior, the kinetics of the devitrification transformation was investigated using isothermal experiments and modeled with classical nucleation theory. Predictive behavior of coating structural changes and resulting performance was then enabled through the development of a Time-Temperature-Transformation diagram to model the devitrification transformation under specific thermal exposures.