Corrosion properties of HVOF manufactured NiCrFeSiB self-fluxing alloy coatings in alkaline solution

Haowei Zhao[1], Feifei Zhang[2] and Mengyan Nie[*,1]*

[1] Institute for Materials discovery, University College London, London, United Kingdom;

[2] TWI Ltd, Cambridge, United Kingdom

** Correspondence email: mengyan.nie@ucl.ac.uk*

In this paper, Ni-base self-fluxing alloy (NiCrFeSiB) coatings were prepared on the carbon steel substrates using high velocity oxygen fuel (HVOF) technology under different oxygen flow rates to investigate the feasibility of applying them for down-hole drilling. The microstructure, morphology and elemental distribution of the as-prepared coatings were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersive X-ray (EDX) analysis techniques. The corrosion properties of the as-prepared coatings were assessed in an alkaline solution of 0.1 mol L^{-1} sodium hydroxide using electrochemical corrosion techniques, including open-circuit potential (OCP), electrochemical impedance spectroscopy (EIS), and polarization curves. All corrosion testing results demonstrated that the as-prepared coatings exhibit enhanced corrosion resistance in the alkaline testing solution compared with the carbon steel substrates, in addition to significantly enhanced hardness. The corroded coatings samples were further analyzed using SEM, EDX and contact angle to understand the corrosion mechanisms of the self-fluxing alloy NiCrFeSiB coatings in the alkaline environment. Combined with optimized HVOF technology, NiCrFeSiB self-fluxing alloy demonstrated great potential as drill bit coatings for down-hole drilling.