Aqueous corrosion of Ni-Al Composite Coatings by Combustion-Assisted Flame Spraying

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A new, cost-efficient and on-site-applicable thermal spraying process for depositing NiAl metallic overlay coatings or bond-coats for high temperature applications has been developed by synthesizing the desired intermetallic phases from base-metals *in-flight* during oxy-acetylene flame spraying. By adjusting the spraying conditions, excellent Ni-Al-based coatings have been achieved on various substrates, including mild steel, stainless steel and aluminium alloys. The new method is called “Combustion-Assisted Flame SpraYing”, (“CAFSY”) and its viability has been demonstrated at a pre-industrial level for coating various metallic parts. The Ni-Al-based coatings produced by CAFSY exhibit very high integrity with good adhesion, very low porosity, high surface hardness and high erosion resistance at a substantially lower cost than equivalent coatings using ready alloy powders, since they are made using only simple oxy-acetylene flame spraying. Thermal treatment of the coatings after spraying (fig. 1b) results in increased concentration of hard intermetallic phases (e.g. NiAl) in comparison with coatings without thermal treatment (fig.1a), at least equivalent to coatings produced by plasma spraying.

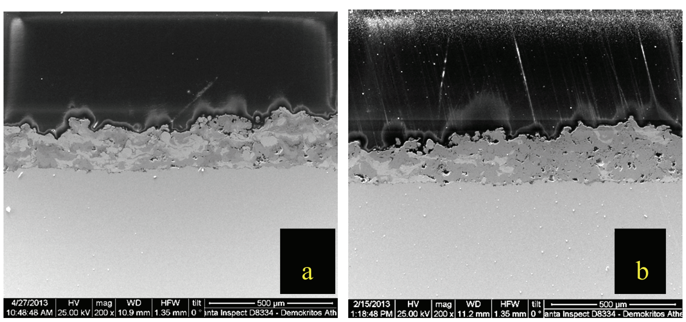

Figure 1. SEM of the coating a) without and b) with thermal treatment of the coating after thermal spraying. The enrichment of the NiAl phase (grey) is evident

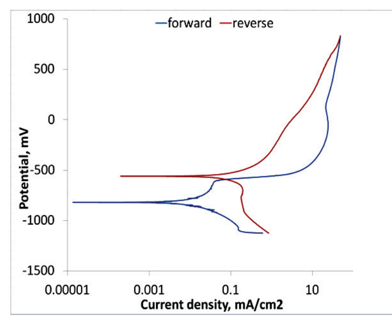

Figure 2. Electrochemical behavior of a NiAl coating in 3.5% NaCl

The coatings have been characterized by measurement of their adhesion strength, air-born erosion, etc, as well as aqueous corrosion. The corrosion performance of the coatings in 3.5% NaCl, at 25 °C was measured by potentiodynamic polarization, chronoamperometry followed by SEM/EDS analysis. Extended immersion of the materials in 3.5% NaCl induces a multiple stage passivation/pseudopassivation, as indicated by the large passive current density. The current density corresponding to the reverse anodic polarization scan was lower than the current densities during the forward anodic polarization scan, as shown in Figure 2. This indicates that these coatings exhibit a high resistance to localized corrosion in 3.5% NaCl.

The work is continuing with adaptation of the CAFSY method for industrial use and for coating other types of intermetallics.