Cost-effective internal-surface EHLA CRA cladding for casing corrosion mitigation in geothermal applications

Tomaso Maccio[1], Josh Barras[2], Jhonattan Gutjahr[2]

2- TWI Technology Centre, Wallis Way, Catcliffe, Rotherham S60 5TZ, UK

Corresponding author: tomaso.maccio@twi.co.uk

Geothermal energy is a widely-available, stable source of green energy. One of the reasons impeding the widespread deployment of this renewable energy source is geothermal aggressive environment: high pressure and high temperature (HPHT) conditions, and corrosive species, threatening the integrity of various components. One approach would be use of corrosion resistant alloys (CRAs) for manufacturing the components. However, such expensive materials will cause huge increase in upfront investment. A more cost-effective approach would be deposition of CRAs using the extreme high-speed laser application (EHLA) cladding process on carbon steel. This will save significant costs and environmental load compared to using monolithic CRAs in large scales. Moreover, EHLA can operate at ultra-high processing speeds in comparison to conventional laser cladding, improving the production rate for large operations.

In this study, samples were manufactured by depositing nickel-based metal powder on the internal surface of API-5CT casing steel, K55, using the EHLA technique. Process parameter studies were performed to achieve the optimised cladding properties, including density, thickness, dilution, flaws and microstructure. A selection of these was then tested in a representative geothermal environment, (i.e. a brine containing H_2S/CO_2, at up to 200°C and a total pressure of up to 200 bar. Corrosion performance of the samples was assessed and compared with that of carbon steel. Immersion testing included pitting and crevice corrosion testing, followed by post-test materials characterisation of the tested coupons.