Issue 2, January 2019

GEO-COAT

Developing high performance coatings for geothermal applications

Geo-Coat investigates materials for corrosion & erosion resistant coatings

We are currently working on the optimisation of production parameters for corrosion-erosion resistant materials. A Design of Experiment approach is being adopted in all cases, where the produced materials are analysed and ranked against properties such as microstructural features, corrosion and erosion resistance.

Candidate materials & methodology:

Our coatings are based on selected *High-entropy alloy (HEA's, produced by mechanical alloying), Cermets and Metal matrix composites (MMC)*. We use High-velocity oxygen fuel spray (HVOF), laser metal deposition(LMD) and electrospark deposition to produce HEA and cermet coatings. Nickel- and Titanium-based MMCs, aimed at pump impeller applications, are being produced by Uniaxial Hot Pressing and Hot Isostatic Pressing while the of Ni-P based coatings suitable for heat exchangers are being produced by electroless plating.

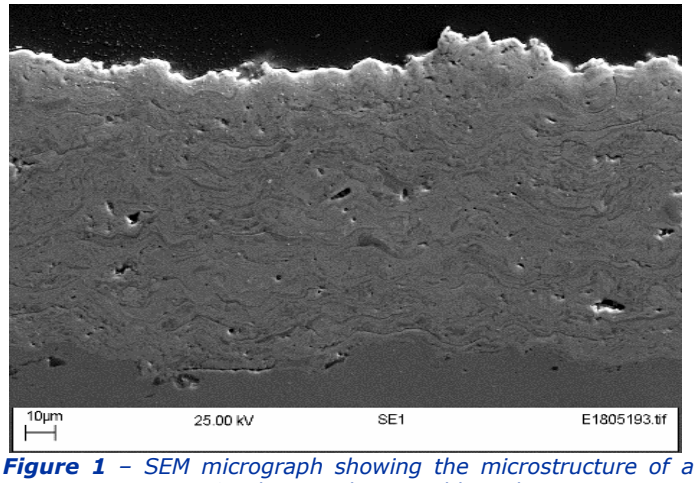

***Figure 1** – SEM micrograph showing the microstructure of a high-entropy coating HVOF-deposited onto mild steel*

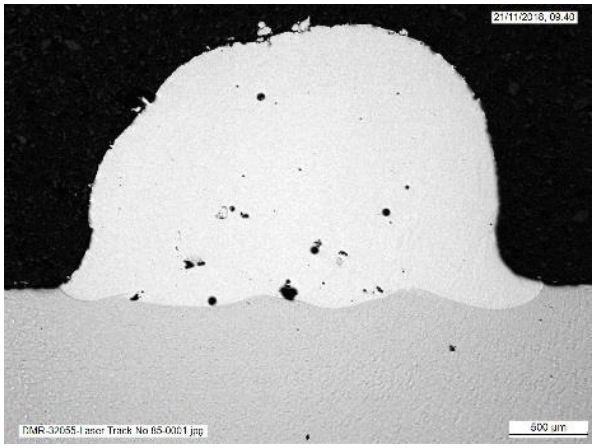

***Figure 2** – Optical micrograph showing the microstructure of a high-entropy alloy coating track obtained by laser metal deposition onto a mild steel substrate (TWI Ltd.)*

LMDs for HEA synthesis:

We use LMD to deposit mechanically-alloyed high-entropy alloy powders. The complexity of the powders to be deposited, containing multiple phases and often grits of single elements, make the cladding optimisation challenging, with porosity often found as a characteristic feature.

By: Dr. Francesco Fanicchia, TWI Ltd.(UK)

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Simulated environments – testing benefits and purpose

What is a simulated geothermal environment?

Natural geothermal conditions are mimicked in the laboratory conditions. Here, we think of experimental apparatus able to replicate geothermal area with physical and geochemical properties as temperature, pressure or geochemical composition of the geothermal fluids and its mass flow, particularly one (liquid) or two-phase (liquid-gas) flow dependent on the pressure of interest. Advantage of such experimental approach is controlled selection/values of tested parameters.

The Purpose

Geothermal fluid or environment has an aggressive and corrosive effect on materials when in direct contact to the geofluid. This can result in premature material failures. The aim is to achieve the simulated environment similar to the real geothermal environment and test novel alloy coatings protecting the materials currently used. Laboratory testing is able to pre-select best candidates for real, field based, application and therefore cut down and prevent expenses on material replacement due to premature material failures.

Methodology

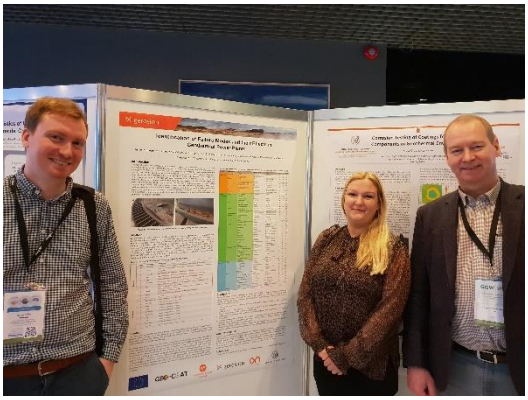
The samples are coated with the alloys under investigation and placed inside the laboratory reactor through which the simulated geothermal fluid and gas will flow and interact with the samples. Various scenarios are scheduled based on the parameters and chemistry in different sections of the geothermal power plants.

Interpretation of Results

Using the simulated geothermal environment, the developed coatings will be investigated for resistance to nucleation of localized corrosion, and to initiation of cracks occurring in the real geothermal environment. The results of experimental corrosion investigation on the novel coating are compared to materials from geothermal power plants and field tested samples at the same time. Together recommendations on coating formulation and coupon selection, i.e. resistance to nucleation of localized corrosion or initiation of cracks, can be provided.

By - *Dr. Danyil Kovalov, Dr. Jan Prikryl, Dr. Sigrún Nanna Karlsdóttir, University of Iceland*

Attended events:



- RoMAT , Bucharest, Romania, 15-18th November 2018.
- GEORG geothermal workshop, Reykjavík , Iceland 14-15th November
- BioMMEDD 2018, Cluj-Napoca, ROMANIA, 27-29th September 2018

Upcoming events

NACE Corrosion Nashville, Tennessee, 24-28th March 2019

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