Coatings for Use at High Temperatures
Room On Demand - Session AP

Coatings for Use at High Temperatures (Symposium A) Poster Session

AP-3 Microstructural Growth and Oxidation Performance of Ti_xSi_y on ɣ - TiAl*, **Josefina Crespo Villegas (joseffina.crespo@polymtl.ca)**, S. Brown, E. Bousser,* Polytechnique Montreal, Canada*; M. Cavarroc,* Safran Tech, France*; S. Knittel,* Safran Aircraft Engines, France*; L. Martinu, J. Klemberg-Sapieha,* Polytechnique Montreal, Canada

For several decades now Ti-Al intermetallic compounds have been considered attractive materials for structural applications because of their low density and good mechanical characteristics. One area of particular interest is the use of γ-TiAl for low pressure turbine components of aircraft engines, as a replacement for much heavier Ni-based superalloys. Despite this advantage in terms of density, the usage of γ-TiAl is currently limited to the coldest low pressure turbine stages of the engine, due to its oxidation susceptibility above 750°C.

In the current work, we explore the oxidation protection of γ-TiAl using titanium silicide (Ti_xSi_y) coatings which have been shown to have strong temperature stability (melting point > 2000°C), and a relatively good oxidation resistance due to the growth of a protective SiO_2 oxide scale. The Ti_xSi_y coatings are synthesized in a two-step process: silicon is first deposited on γ-TiAl substrates by RF magnetron sputtering, and the coated substrates are then thermally annealed at 950°C in vacuum. The influence of (i) silicon thickness and (ii) thermal annealing time on the growth and the microstructure of the titanium silicides is investigated, with tested values ranging from 3–9.5 µm of silicon and 2-24 hours of thermal annealing. Both of these parameters are shown to directly affect the thickness and composition of the different zones in the ɣ- TiAl/Ti_xSi_y coating system. In particular, it is noted that beginning with a thicker silicon layer results in more varied compositions of Ti_xSi_y, and that increasing the annealing time improves the uniformity of each individual zone as well as increasing the total thickness of the coating system.

Following annealing, the oxidation performance of the coatings is tested by exposing them to a temperature of 900°C in air for 100 hours. The mass gains during oxidation are recorded, and changes to the chemistry and microstructure of the samples are analyzed. Oxidation of the coated samples is estimated to be parabolic, and all samples show a marked improvement in oxidation resistance, with mass gains 2-3 times lower than those observed for the bare γ-TiAl.

AP-4 Lowering Costs by Improving Efficiencies in Biomass Fueled Boilers: New Materials and Coatings to Reduce Corrosion (BELENUS)*, A. Illana, V. Encinas-Sánchez, M. de Miguel, M. Lasanta, G. García-Martín,* ***Francisco Javier Pérez Trujillo (fjperez@ucm.es)****,* Universidad Complutense de Madrid, Spain

The primary objective of BELENUS is to lower bioenergy CAPEX and OPEX by an average of 5 and 60% respectively. This will be addressed by preventing or mitigating corrosion as the main limiting factor through a holistic approach to prevent corrosion in the boiler, in particular in superheater (SH) tubes: a) new surface engineering: biomass corrosion highly resistant coatings on creep resistance materials; b) new strategies of welding and bending for coated tubes improving the quality and efficiency of boiler components; and c) new online corrosion monitoring system specifically designed for biomass CHP plants. In addition, the BELENUS solution will impact on other LCOE parameters by improving efficiency in the conversion (up to 42%), increasing a 5% the operational hours of the plant and plant life time (5 years) and reducing the fuel expenditure of the plant by optimising its use and providing flexibility by allowing the use of different types of biomass. Improved performance for high temperature material systems through the technological breakthroughs, will be evaluated and validated an innovative test protocol. Finally, modelling and lifetime prediction tools will be developed and cost analysis and Life Cycle Analysis (LCA) undertaken so the optimum materials and coatings are chosen from the durability, economic and environmental perspectives, maximising the sustainability in economic and environmental terms. BELENUS brings together a multidisciplinary consortium comprising the main stakeholders with leading utilities, steel and tube developers, boiler designer and specialized research institutions from across Europe. This synergy allows a direct transfer of results in TRL5 to be obtained in BELENUS as technical base to go further to higher TRL into commercial biomass electric power plants within less than 5 years.

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