Protective and High-temperature Coatings
Room Town & Country A - Session MA1-2-TuA

Coatings to Resist High-temperature Oxidation, Corrosion, and Fouling II

Moderator: Vladislav Kolarik, Fraunhofer Institute for Chemical Technology ICT, Germany

2:20pm **MA1-2-TuA-3 Advanced Chemical Vapor Deposition Technology for High Temperature Applications**, ***Natasa Djordjevic [natasa.djordjevic@ihi-bernex.com]***, *Anne Zhang, Hristo Strakov,* IHI Bernex AG, Switzerland

Recent research explores the potential of Chemical Vapor Infiltration (CVI) and Chemical Vapor Aluminizing (CVA) technologies to produce advanced coating solutions for high temperature applications and materials with enhanced performance at demanding conditions.

CVI is increasingly used for establishing coating solutions for fiber-reinforced composites, enabling deposition of interface layers or infiltration of ceramic matrices with different precursors at elevated temperatures. The technique allows production of materials with greatly enhanced properties such as thermal stability, mechanical strength, oxidation and corrosion resistance.

On the other hand, CVA is a modern advanced process for applying diffusion coatings on metallic-based turbine blades and vanes in the hot section of aero- and land-based turbines against oxidation and corrosion. The CVA process is capable of controlled alloying the coating with additional elements by using metal chlorides and tight control of the coating composition and on this way increasing the life time of such components.

This work will highlight the latest developments of different coating technology solutions for high temperature applications, including improvements in precursor chemistry, reaction kinetics, stoichiometry and process control. Emphasis will be placed on the challenges related to maintaining uniformity and quality of deposition in different geometries and the influence of the coating equipment in order to precise control the parameters.

2:40pm **MA1-2-TuA-4 Oxygen Concentration Governs High-Temperature Oxidation Behavior of $(Cr_{0.5}Al_{0.5})(O_YN_{1-Y})$ Thin Films**, ***Pauline Kümmerl [kuemmerl@mch.rwth-aachen.de]***, *Felix Leinenbach, Janani Ramesh,* RWTH Aachen University, Germany*; Daniel Primetzhofer,* Uppsala University, Sweden*; Marcus Hans, Jochen M. Schneider,* RWTH Aachen University, Germany

In (TM,Al)(O,N) (TM = Ti, V) thin films, the addition of oxygen enhances the thermal stability as for the decomposition into the hexagonal and cubic phases mobility on the metal and nonmetal sublattices is required, while for (TM,Al)N decomposition the activation of diffusion on the metal sublattice is sufficient. Little is known about the oxidation resistance of (TM,Al)(O,N) thin films; thus a systematic study of the influence of the O concentration in (Cr,Al)(O,N) on the oxidation resistance and oxide scale formation is presented here.

$(Cr_{0.5}Al_{0.5})(O_YN_{1-Y})$ thin films were grown by reactive high power pulsed magnetron sputtering where the O content was systematically varied through adjustment of the O_2 partial pressure leading to compositions of $(Cr_{0.50}Al_{0.50})_{0.49}N_{0.51}$, $(Cr_{0.48}Al_{0.52})_{0.48}(O_{0.15}N_{0.85})_{0.52}$, and $(Cr_{0.44}Al_{0.56})_{0.46}(O_{0.40}N_{0.60})_{0.54}$. The oxidation behavior was investigated as a function of the O concentration at 1000 °C, 1100 °C, and 1200 °C for up to 16 h.

During oxidation an Al-rich oxide scale is formed. Between the $(Cr_{0.5}Al_{0.5})(O_YN_{1-Y})$ thin films and the scale, the formation of a an Al-depleted and O-enriched region is observed whereby the geometric extent and the level of porosity were strongly time and temperature dependent. At 1100 °C after 16 hours of oxidation the oxide scale thickness on $(Cr_{0.48}Al_{0.52})_{0.48}(O_{0.15}N_{0.85})_{0.52}$ was with 369± 48 nm significantly smaller than the 513± 96 nm and 462± 53 nm thick scale layers measured on $(Cr_{0.50}Al_{0.50})_{0.49}N_{0.51}$ and $(Cr_{0.44}Al_{0.56})_{0.46}(O_{0.40}N_{0.60})_{0.54}$, respectively. Furthermore, chemical environment dependent DFT calculations are performed to determine the species specific energy requirements for vacancy formation and mass transport in an effort to elucidate the time and temperature dependent oxidation behavior.

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