Foreword

Materials for High-Temperature Applications: Next Generation Superalloys and Beyond

Materials employed at high temperatures will be in demand in the foreseeable future in many applications among which energy and transportation are the leading sectors. In energy, diminishing conventional resources and the pressure to utilize them with less environmental impact are driving the search for more efficient (*i.e.*, operating at higher temperatures and pressures) power generation plants. Lowering operating cost by increasing efficiency (*i.e.*, reducing fuel usage) is another important driver for both the energy and transportation industries. More efficient technologies are being developed for many applications; however, lack of appropriate high-temperature materials which can perform for the required length of time is usually a huge barrier for the new technologies.

The current high-temperature turbines utilize state-of-the-art nickel-based superalloys in the hottest sections. These materials possess excellent creep strength because they contain high volume fraction of γ' precipitates coherent with the γ matrix and excellent high-temperature oxidation resistance due to ability to form protective oxide scales on the surface. However, these alloys perform at their temperature capability limit, and there is not much room left for improvement since the application temperatures are already very near their melting points. Thus, the search for higher-temperature materials systems that can withstand extreme environments and be fabricated into both rotating and stationary components is critical to the success of future propulsion and power generation systems.

A symposium titled "Materials for High Temperature Applications: Next Generation Superalloys and Beyond" was organized at the TMS Annual Meeting in February 17 to 20, 2014 in San Diego, CA with the sponsorship from the Refractory Metals Committee and High Temperature Materials Committee of TMS. The goal of this symposium was to review recent advancements in materials systems intended to replace the conventional superalloy systems in next generation high-temperature applications. More than fifty presentations were given in six sessions. Focus areas included applications driving the high-temperature materials research, oxidation and coatings, Nb-based alloys, Mo-based alloys, Ni-based alloys, and other emerging materials such as high-entropy alloys, Pt-based superalloys, and MAX phase containing alloys.

In the following pages, two papers from this symposium are published. The first paper deals with directionally solidified NiAl-V eutectic alloys and their mechanical behavior. The authors report increased fracture toughness in these materials compared with NiAl due to the ductile vanadium phase. The second paper is a report of a density functional theory (DFT) study on thermodynamic and elastic properties of intermetallic binary and ternary phases in the Nb-Si-Al-Sn system.

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