# Materials for the Nuclear Renaissance

## Foreword

The symposium "Materials for the Nuclear Renaissance" was held during the TMS 138th Annual meeting in San Francisco, California, February 15–19, 2009. Brian V. Cockeram, Bechtel Bettis, Inc., acted as co-chair for this symposium. Twenty-four presentations were made in the field of material behaviors for nuclear power plant applications, ranging from experiences and past limitations to proposed materials for the newer designs. Materials discussed included ceramics, stainless steels, and nickel, zirconium, molybdenum, and beryllium alloys. The type of studies included novel characterization techniques, comparative environmental degradation resistance, and mechanical behavior. This was a multirepresentative international symposium including researchers from industry, universities, and national laboratories from the Americas, Europe, and Asia.

The following eight articles discussing materials in nuclear power represent a good cross section of the symposium. Two articles are on the characterization of the behavior of Alloy 617 during high-temperature testing. Alloy 617 is a candidate material for the next generation of power plants where higher temperatures may be used. There is basic characterization work on the effects of silicon when it is added to austenitic stainless steels. During the irradiation of stainless steels, silicon may segregate to grain boundaries and contribute to their failure in service. One article examines the high-temperature application of titanium aluminide and its resistance to creep, and another work deals with the comprehensive characterization of molybdenum after mechanical testing. One article examines the development of a ceramic-lined crucible to be used in the processing of uranium. Finally, there are two articles related to the end of the life of some materials in nuclear energy, the first on the mechanical behavior of zirconium alloy and the second on the characterization of waste form minerals. As stated previously, these eight articles represent the entire and varied spectrum of materials that are the subject of nuclear energy, from candidate materials for new nuclear plants to what happens to the materials when their useful life in the plant is over.

It is likely that the title of the symposium "Materials for the Nuclear Renaissance" was too ambitious when it was first proposed to the TMS Nuclear Materials Committee in 2006. At that time, it was expected that by 2009 a more clear and rapid resurgence of the nuclear power industry would be occurring. We are now witnessing that the nuclear energy renaissance is modest at best and that it is progressing at a much slower rate than initially anticipated, at least in the United States and Europe. According to the International Atomic Energy Agency (IAEA), there are currently 45 nuclear power reactors under construction in the world, and most of these new reactors (~80 pct) are in Asia. However, it appears that the public acceptance of nuclear energy is increasing and that nuclear energy is here to stay. For example, this year Italy has decided to rejoin the international nuclear energy community after a hiatus of several years, during which it had decommissioned all of its nuclear power plants. In the United States, many plants are requesting and being granted life extension licensing beyond 40 years. At the same time, the issue of nuclear waste production and proliferation needs to be solved. Many countries have been studying for decades the viability of stable geologic formations as repositories for nuclear waste, but, to this moment, none has been built. The United States had one of the most advanced designs for a repository, but this Yucca Mountain project seems now to be on the very back burner.

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