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## FOREWORD

This is the thirty-eighth in a series of semiannual technical progress reports on fusion materials science activities supported by the Fusion Energy Sciences Program of the U.S. Department of Energy. This report focuses on research addressing the effects on materials properties and performance from exposure to the neutronic, thermal, and chemical environments anticipated in the chambers of fusion experiments and energy systems. This research is a major element of the national effort to establish the materials knowledge base of an economically and environmentally attractive fusion energy source. Research activities on issues related to the interaction of materials with plasmas are reported separately.

The results reported are the product of a national effort involving a number of national laboratories and universities. A large fraction of this work, particularly in relation to fission reactor irradiations, is carried out collaboratively with partners in Japan, Russia, and the European Union. The purpose of this series of reports is to provide a working technical record for the use of program participants, and to provide a means of communicating the efforts of fusion materials scientists to the broader fusion community, both nationally and worldwide.

This report has been compiled and edited under the guidance of R. L. Klueh and Teresa Roe, Oak Ridge National Laboratory. Their efforts, and the efforts of the many persons who made technical contributions, are gratefully acknowledged.

G. R. Nardella  
Research Division  
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Bend stress relaxation (BSR) creep experiment was performed using thin strip specimens machined out of chemically vapor deposited (CVD) SiC in two different material classes, in a stress range of general interest for structural ceramics and composites. The primary objective of the experiment was to demonstrate the applicability of BSR technique to the thermal and irradiation creep studies of bulk SiC. Additionally, it was attempted to help understanding the high temperature deformation mechanism for high purity and stoichiometric SiC using the limited data obtained.

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The objective of this work is to determine tensile properties of structural ceramic composites with reinforcement by Tyranno™-SA Grade-3 near-stoichiometric silicon carbide (SiC) fiber fabrics, pyrolytic carbon (PyC) interlayer, and SiC matrix densified through forced-flow chemical vapor infiltration process. An emphasis was put on role of the PyC interlayer on various tensile and fracture properties of the composites.

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The primary objective of this study is to identify the optimum interlayer design of multiple pyrolytic carbon (PyC) / silicon carbide (SiC) interphase. For this purpose, the effect of interlayer thickness on interfacial shear properties of (non-irradiated) SiC/SiC composites with single PyC interphase and multiple PyC/SiC (ML) interphase is specifically addressed on.

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The objective of this task is to assess the long-term, high-temperature compatibility of high electrical resistance, multi-layer coatings with lithium at high temperatures. Electrically insulating coatings on the first wall of magnetic confinement reactors are essential to reduce the magnetohydrodynamic (MHD) force that would otherwise inhibit the flow of the lithium coolant. An assessment of the crack tolerance for these coatings determined that a multi-layer coating with metal and ceramic layers was needed to prevent Li from wetting cracks or defects in a single-layer ceramic coating. Experimental compatibility tests are being conducted on bulk materials and single and multi-layer coatings.

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This research has two main objectives.

- On one side is the development of computational tools to evaluate alloy properties, using the information contained in thermodynamic functions to improve the ability of classic

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- On the other hand, to apply the tools so developed to predict properties of alloys under irradiation.

<b>9.4</b>	<b>TOWARDS UNDERSTANDING THE FORMATION AND STABILITY OF NANOMETER SCALE Y-Ti-O CLUSTERS IN NANOSTRUCTURED FERRITIC ALLOYS USING LATTICE-BASED MONTE CARLO SIMULATIONS</b> —M. J. Alinger and B. D. Wirth (University of California, Berkeley)	<b>124</b>
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This work is being carried out under Annex I of the Collaboration on Fusion Materials between the U.S. DOE and the Japan Atomic Energy Research Institute. The JP-28 and JP-29 capsules are part of the Phase-IV experiments with the goal of elucidating the effects of helium in candidate engineering and model alloys, and verifying the irradiation response of alloy F82H. These two capsules will extend the irradiation to significantly higher levels than the previous capsules in this series, JP-26 and JP-27, with planned exposure to greater than 50 dpa.