SiC as a material for application in generation IV systems: electronic, structural and mechanical properties

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Abstract

There are many challenges to overcome before Generation IV fission reactors become commercially viable. Some of the most important challenges in both thermal [Very-High-Temperature Reactor (VHTR), Supercritical-Water-Cooled Reactor (SCWR), and Molten Salt Reactor (MSR)] and fast reactors [Gas-Cooled Fast Reactor (GFR), Sodium-Cooled Fast Reactor (SFR), and Lead-Cooled Fast Reactor (LFR] involve materials issues. They include the material employed in the reactor walls, the cladding material for the fissile nuclear fuel, and the material used for retaining the fission products. In addition to long term resistance to irradiation, the materials used in a nuclear reactor must have excellent mechanical and corrosion properties in order to tolerate the thermal shocks as well as the high temperature and severe corrosive environments that they will encounter during operation. One of the materials that has long been considered for this purpose is SiC, a material that is used both for its ceramic characteristics, as well as its wide bandgap semiconducting properties. In this talk, we discuss recent results on the mechanical and fracture properties of SiC and how the various defects affect the electronic properties of this high-temperature semiconductor.