Novel Amorphous SiOC Dispersion-Strengthened Austenitic Steels

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A novel amorphous silicon oxycarbide dispersion-strengthened (SiOC-DS) austenitic steel has been fabricated via a powder metallurgy process. The microstructure of dispersion particles has been characterized by transmission electron microscopy and electron backscatter diffraction, revealing that amorphous SiOC nanoparticles with an average particle size of 30 nm are homogeneously distributed in the austenite grains with a sub-micrometer grain size. The high strength and hardness of SiOC-DS may be attributed to grain boundary strengthening, as well as dispersion strengthening via dislocation-particle interactions that are revealed by TEM investigations. In-situ ion irradiation experiments show that amorphous SiOC particles are stable after irradiation of 3.7 dpa, and the SiOC/steel interface can be effective sinks for the annihilation of irradiation defects. The excellent mechanical and irradiation properties of SiOC-DS austenitic steel make it a promising structural material for nuclear applications.