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Effect of a silicon dioxide diffusion barrier layer on the migration of strontium implanted into SiC

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Polycrystalline SiC wafers were implanted with 300 keV strontium ions at room temperature to a fluence of 2×10^16 cm^−2. Silicon dioxide (SiO2) layers of about 100 nm thick were deposited onto the surface of implanted SiC via magnetron sputtering of a SiO2 target in argon-oxygen atmosphere. The as-deposited (i.e., SiO2/implanted SiC) samples were subjected to sequential isochronal annealing, under vacuum, at temperatures ranging from 1100 to 1400 ˚C in steps of 100 ˚C for 5 h. The effect of annealing on the surface topography and migration of strontium in SiC and SiO2 layers were investigated by scanning electron microscopy (SEM), scanning transmission electron microscopy (STEM) and Rutherford backscattering spectrometry (RBS), respectively. RBS and STEM results showed that annealing at 1100 and 1200 ˚C, caused strong strontium segregation toward both SiO2/SiC interface region and SiO2 surface. The migration of strontium from SiC to the SiO2 layer at 1100 and 1200 ˚C enhanced the sublimation of SiO2 in an ultrahigh vacuum chamber, where the pure SiO2 layer (i.e., without impurities) showed no sublimation after annealing under the same conditions. However, further annealing, at 1300 and 1400 ˚C, showed strong sublimation of the pure SiO2 layer. This indicates that SiO2 is not suitable for use as an additional diffusion barrier for SiC since temperatures in a nuclear reactor can reach 1600 ˚C during accidence conditions.

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Footnotes

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