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Interfacial reactions and surface analysis of W thin film on 6H-SiC

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Tungsten (W) thin film was deposited on bulk single crystalline 6H-SiC substrate and annealed in H2 and Ar ambient at temperatures ranging from 700 to 1000 °C for 1 hour. The resulting solid-state reactions, phase composition and surface morphology were investigated by Rutherford backscattering spectroscopy (RBS), grazing incidence X-ray diffraction (GIXRD) and scanning electron microscopy (SEM) analysis techniques. As-deposited RBS results indicate the presence of W and O₂ in the deposited thin film, the XRD showed the presence of W, WO₃, W₅Si₃ and WC. RBS results indicated the interaction between W and SiC accompanied by the removal of oxygen at 700 °C for the samples annealed in H₂ ambient. The XRD analysis indicated the presences of W₅Si₃ and WC in the samples annealed at 700 °C. At temperatures of 800 °C, 900 °C and 1000 °C, W further reacted with the SiC substrate and formed mixed layer containing silicide phases and a carbide phase. That is, W₅Si₃, WSi₂ and WC for the Ar ambient and W₅Si₃, WSi₂, WC and W₂C for H₂ ambient. The SEM micrographs of the as-deposited samples indicated the W thin film had a uniform surface with small grains. Annealing at 800°C led to the agglomeration of W grains into clusters for the H₂ annealed samples. SEM micrographs of the Ar annealed samples at 800 °C indicated randomly orientated large crystals growing on top of each other on the surface.

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