Epitaxial growth of Ti_3SiC_2 thin film onto α-SiC

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Ti_3SiC_2 is a member of the family of layered ternary compounds well-known as the MAX phases which exhibit typical ceramic and metallic properties. Thin-film of Ti_3SiC_2 could become suitable for many applications such as electrical contacts and wear protective coatings. Then, it is crucial to progress in the knowledge of the physical properties of Ti_3SiC_2 thin film. The objective of this study is to synthesize the MAX phase Ti_3SiC_2 onto SiC substrate using TiAl thin film deposition. Transmission electron microscopy was performed to understand the nucleation and growth mechanism of Ti_3SiC_2 onto SiC. Experiments were conducted on three different α-SiC substrates ((0001) and (11-20) n-type 4H-SiC single crystals from Cree research and Hexoloy polycrystalline 6H-SiC from St Gobain). Al and Ti were co-deposited in a 200 nm-thick thin film at room temperature by magnetron sputtering of metallic Al and Ti target in Ar atmosphere. After deposition the samples were annealed at 1000°C under Ar atmosphere allowing to obtain the MAX phase. HRTEM observations on cross-sectional samples revealed that Ti_3SiC_2 grow preferentially along the SiC basal plane by a step flow mode on SiC surface according to a heterogeneous surface nucleation mechanism.