Selective Area Epitaxial Growth of Magnesium Diboride on SiC using Epitaxial Graphene

*P.A. Rondomanski, C. Dong, Q. Li, and J.M. Redwing

Abstract: Magnesium Diboride (MgB_2) is well known as the highest temperature BCS superconductor that doesn't require external pressure to achieve a bulk transition temperature of 39 K. MgB_2 possesses a two-gap contribution to its superconductivity, a small energy gap of ~2.3 meV due to π band contributions and a larger σ band energy gap of ~7.1 meV. The desirable σ band carriers are mostly confined to a superconducting state accessible via the *M*-plane of the crystal. Accessing this band energy gap via a film is traditionally difficult due to synthesis being largely limited to C-plane films. In this work we present selective area epitaxial growth of *C*-plane MgB_2 using patterned epitaxially grown graphene on SiC (EG). Here, the EG restricts MgB_2 deposition predominantly to exposed SiC. This allows access to study MgB_2/graphene Josephson junctions using the high band energy gap due to the lateral orientation of the device. Moreover, this technique allows for direct synthesis of other MgB_2 devices, such as thin film nanoribbons, without the contamination and degradation of the material from standard lithography processing. These superconducting nanoribbons may have applications as single photon detectors or as other quantum sensors. Discussions will include preliminary results of electrical properties of as-grown nanoribbons and the synthesis considerations of developing these structures.