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All-MgB_2 sandwich-type Josephson junctions with MgO barrier[1]

KE CHEN, CHENGGANG ZHUANG, QI LI, Deparment of Physics, Penn State University, University Park, PA 16802, YE ZHU, PAUL VOYLES, Department of Materials Science and Engineering, University of Wisconsin, Madison, WI 53706, X. X. XI, Department of Physics and Department of Materials Science and Engineering, Penn State University, University Park, PA 16802 — Reproducible all-MgB_2 Josephson junctions have been made to meet the expectation for superconducting electronics that can work at above 20 K. The sandwich-type junctions were fabricated using MgB_2 electrodes grown by hybrid physical-chemical vapor deposition and MgO barrier deposited by RF magnetron sputtering. The $I-V$ characteristics show tunneling behavior with a small resistive shunt. The I_cR_n-product is 2.1 and 0.7 mV at 4.2 and 20 K, respectively, with temperature dependence following the theory qualitatively. The junctions exhibit good Fraunhofer pattern and Shapiro steps under applied magnetic field and microwave radiation, respectively. The J_c of the junction varies exponentially with the barrier thickness, from 100 to 2×10^5 A/cm^2. Transmission electron microscopy reveals both MgB_2 layers are epitaxially grown with c-axis parallel to the SiC (0001) substrate normal. With the same chip J_c spead less than 10%, this junction technology has the potential for MgB_2 circuits.

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