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Thin film growth of ZrB2 on 4H-SiC(0001) for potential electrical contact applications

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Zirconium diboride, ZrB2, is a representative of the transition metal diborides. It exhibits typical ceramic properties including high hardness and high melting point. In addition, ZrB2 has low resistivity and a small lattice mismatch to the semiconductor materials SiC and GaN, making it interesting as a possible contact material. Here, ZrB2 thin films were deposited using dc magnetron sputtering in an industrial scale high vacuum deposition system, CemeCon CC 800®/9 ML. The depositions were made from a compound target operated at a fixed target to substrate distance of 7 cm and the power density applied to the target was 12 W/cm2. The process pressure was 0.5 Pa. The deposition time was 100 s, aiming for a film thickness of 300 nm. A series of films with different substrate bias voltages (-20V, -40V, -60V, -80V) was made at substrate temperatures of approximately 35 °C, 550 °C and 700 °C. X-ray diffraction (XRD) shows that the crystallographic orientation of the films grown on Si(100) and 4H-SiC(0001) substrates changes from 0001 with no external heating to 10$\bar{1}$1 at higher deposition temperatures. In the films deposited at 550 °C both the 0001 and the 10$\bar{1}$1 peaks are present whereas at 700 °C only the 10$\bar{1}$1 peak is encountered. XRD patterns show that for the 0001-oriented films there is a shift of the 0001 and 0002-peaks to lower diffraction angles with higher bias, consistent with higher stresses in the films grown at higher bias voltages. Four point probe measurements yield typical resistivity values of the film on Si(100) ranging from ~95 to 176 μΩcm; the trend being towards lower resistivity values for films deposited at higher temperatures and using higher substrate bias. The films deposited on 4H-SiC(0001) follow the same trend, but with slightly higher values, ~108 to 211 μΩcm.Results from transmission electron microscopy, elastic recoil detection analysis and thickness measurements, using scanning electron microscopy, will be presented.

Keywords
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contact material