HIGH-CRYSTALLINE QUALITY Si-DOPED β-Ga2O3 WITH DIFFERENT SURFACE ORIENTATIONS BY HOT-WALL MOCVD

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A new growth approach, based on the hot-wall metalorganic chemical vapor deposition concept, is developed for high-quality homoepitaxial growth of Si-doped single-crystalline β-Ga2O3 layers on native substrates [1,2] with different surface orientations: (-201), (010) and (001).

All types of β-Ga2O3 substrates were annealed in an argon atmosphere at temperatures below 7500C, for the formation of epi-ready surfaces, as a cost-effective alternative to the traditionally employed annealing process for oxide substrates in oxygen-containing atmosphere (1 h at 1000 -11000C). The best results in this respect were achieved for the (010)-oriented β-Ga2O3 substrates annealed for 1 min at temperatures below 6000C. Moreover, the overgrown by hot-wall MOCVD epilayers demonstrated very smooth surface morphology with a root mean square roughness value of 0.8 nm over a 10 μm x 10 μm area along with a high electron mobility of 69 cm2V−1s−1 at a free carrier concentration n = 1.9×1019 cm−3. These values compare well with state-of-the-art parameters reported in literature for β-Ga2O3 (010) homoepitaxial layers with respective Si doping levels.

The homoepitaxial layers grown on (010) β-Ga2O3 substrates demonstrated superior structural quality in comparison to the (-201) and (001)-oriented ones. Meanwhile, a β-Ga2O3 (020) rocking curve full-widths at half-maximum as low as 11 arcsec is achieved, which is lower than the corresponding one for the melt grown bulk substrates (19 arcsec), even for highly Si-doped (low 1019 cm-3 range) layers. Therefore, the growth approach developed is very promising for deposition of gallium oxide layers of device quality.