Diffraction contrast imaging of ultra-wide bandgap substrates and structures for hetero-integration

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Ultra-wide bandgap materials such as b-Ga2O3 and diamond enable advances in optoelectronic and electronic performance.However, the growth of these substrates differs significantly from growth of previous generations of semiconductors such as silicon, InP and GaAs.Diffraction contrast based imaging is described to relate substrate-based defects with subsequent epitaxial growth for b-Ga2O3 –based systems (thick b-Ga2O3 and b-(AlxGa1-x)2O3 with the formation of extended defects particularly important for vertical transport devices.Cracks forming in b-(AlxGa1-x)2O are also studied using these imaging techniques with major cracks forming along different orientations due to the low symmetry of the b-Ga2O3 lattice.

Bulk diamond growth is achieved via vapor phase techniques and can be separated into homoepitaxial and heteroepitaxial processes.While the crystallinity of the homoepitaxial structures is better than for the heteroepitaxial cases, the heteroepitaxial approach provides a more direct route to large diameters for hetero-integration.Using a series of diffraction images based on different orientations, localized areas of strain and misorientation are clearly resolved and the overall relationship between lattice curvature and wafer curvature are clearly elucidated.

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