A review of key developments and challenges in CVD diamond substrates for electronic device applications

Daniel Twitchen, Element Six (UK) Ltd., Global Innovation Centre, Fermi Avenue, Oxfordshire, United Kingdom

Diamond grown by chemical vapour deposition (CVD) is an outstanding candidate for next generation RF, power, and high temperature electronic devices, due to its ultra-wide band gap, high breakdown field, exceptional thermal conductivity, and excellent intrinsic carrier transport properties. Electronic devices which can harness the properties of diamond have the potential to supersede those based on conventional wide bandgap materials, such as GaN and SiC.

In order for diamond's promise to be realised, a number of materials challenges need to be overcome, including the development of suitable diamond substrates. Intrinsic single crystal diamond substrates with low defect densities and excellent electronic properties have been available for some time, but not of a sufficient size to be compatible with conventional semiconductor processing tools. Conversely, significant progress has been made in developing heteroepitaxially grown single crystal diamond close to 100mm in diameter, but these materials have so far contained relatively high defect densities.

In this talk we review the state of the art in CVD diamond substrates for electronic device applications and discuss potential pathways for developing wafers which combine large area with reduced defect density.