

Diamond material has become the ultimate choice for many fields because of its highest hardness, thermal conductivity, wide transmittance range and excellent electrical properties. In recent years, with the development of chemical vapor deposition (CVD) man-made diamond synthetic technology, the size and quality of diamond materials have been fully developed and the corresponding applications fields have been extended. The preparation technology and related applications of self standing diamond film materials at home and abroad are introduced, and the research progress on the preparation of high-quality diamond film materials are discussed.

Starting from the classification of preparation technology of CVD diamond film materials, the basic principles of various methods were expounded, and the advantages, disadvantages and application scope of various methods were clarified. Based on the four preparation methods, the technical level of CVD diamond film material preparation at home and abroad was investigated. By comparing those technical levels, the research progress of diamond preparation in China was affirmed, and the gap between China and foreign countries on the highest level of CVD diamond preparation was clarified, indicating the direction of future development.

The preparation techniques of CVD diamond films include hot filament chemical vapor deposition (HFCVD), microwave plasma chemical vapor deposition (MWCVD) and DC Arc Plasma Jet CVD. The microwave CVD method has the advantages of high plasma density, no discharge electrode pollution and good control, and it is considered as the preferred method to prepare high quality diamond. The raw gas can be highly ionized and high-density plasma can be generated based on arc discharge in DC Arc Plasma Jet CVD, which could achieve the rapid deposition of high-quality diamond film. The other two methods are mainly used to prepare tool grade and heat sink grade diamond films. HFCVD technology is commonly used to prepare diamond coated products. The largest diamond film in 8 inch has been prepared abroad, and China can also obtain the similar size, but there is still a certain gap between the foreign countries and China in deposition area and equipment stability. Norton company in US has announced to prepare a diamond film material with a diameter of 175 mm by DC Arc Plasma Jet technology, but its arc torch is still from rocket thruster technology, resulting in huge gas consumption in the preparation process and high cost of diamond film, and then disappeared. Domestic scientific research institutions represented by University of Science and Technology Beijing have made breakthroughs in the preparation of self standing diamond films with diameters of 100mm, 125mm and 150mm through independent research and development, and applied them in cutting tools, heat sink and optical window respectively, realizing the large-scale industrial production and application of CVD diamond materials. For MWCVD technology, high quality diamond films with diameters of 120mm and 150mm were prepared by using 915MHz microwave technology respectively abroad, and also successful synthesis of single crystal diamond with diameters of 92mm was achieved. Through independent research and development and the introduction of foreign technologies, China has completed the controllable research and development of a stable and reliable 915MHz microwave chemical vapor deposition equipment, and obtained the high-quality diamond film with a diameter of 127mm, meeting the application requirements of optical window.

At present, the diamond material preparation technology is mature abroad. Compared with foreign countries, China has made some progress in HFCVD technology and MPCVD technology. However, there are still some gaps in diamond size and system stability. Only the rapid development of DC arc plasma CVD technology enables large-scale production of diamond films. In the future, based on the application of diamond in heat sink, the application in optical window will be broken through, and the development will be gradually to the electronic (detector level) diamond materials and devices.