



## **Beyond Jewelry: The Quantum Realm of Diamonds**

Hyunmin CHOI<sup>1\*</sup>, Hanmi Gemological Institute & Laboratory (hmcgem@hanmail.net)  
Youngchool KIM<sup>2</sup>, Hanmi Gemological Institute & Laboratory  
Jaeun KIM<sup>3</sup>, Hanmi Gemological Institute & Laboratory  
Soi MOON<sup>4</sup>, Dongshin University  
Jeongwon SEOK<sup>5</sup>, Dongshin University

### **Abstract**

Known for their exceptional physical properties and beautiful gemstones, diamonds have a wide range of applications in existing industries. Diamonds have a variety of defects that are responsible for their color. NV defects give diamonds their pink color and also give diamonds their quantum properties.

There is current research to use diamonds with NV centers for applications in technologies such as quantum sensing and quantum computing.

The use of NV diamond centers in quantum sensing demonstrates a significant sensitivity to tiny magnetic fields, which shows significant potential. This sensitivity has the potential to bring innovation to medical diagnostics, navigation systems, and precise defect detection in battery manufacturing. At the same time, the stable quantum state maintained by NV diamond centers positions them as ideal candidates for quantum computing.

High purity single crystal diamonds are essential for quantum research using NV centers. There are two main methods of artificially producing diamonds: Chemical Vapor Deposition (CVD) and High Pressure-High Temperature (HPHT).

Initially, synthetic diamonds grown by the HPHT method were used in quantum research. However, this method is now rarely used in quantum research due to challenges in controlling impurity concentrations (NV defects) and a lack of cost competitiveness.

While the CVD method has the disadvantage of slow diamond growth, it has the advantage of producing large areas of high-purity diamond. In addition, the <sup>13</sup>C isotope concentration can be controlled and NV centers can be generated during the diamond growth phase, making CVD grown diamonds the most widely used for quantum research today.

The future of diamond quantum technology cannot be defined with precision, but advances in quantum sensing and computing are expected to impact fields as diverse as healthcare, energy and computing. This study looks at quantum technology research using diamonds beyond their beauty as jewelry.

### **Keyword**

Quantum diamond, NV center, CVD method, Jewelry