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Plasma CVD engineering of diamond nitrogen-vacancy centers for quantum sensing

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Abstract

Nitrogen vacancy (NV) centers in diamond have attracted attention as quantum sensor due to their excellent spin properties such as long coherence time and fast operation. There are several methods for forming NV centers, including introduction during crystal growth, electron beam irradiation, ion implantation, and their combinations. This presentation will focus on plasma CVD engineering and will introduce recent progress in the development of sensor materials and junction devices. In terms of sensor materials, uniformity across the entire crystal and suppression of crystal distortion are important perspectives, along with thicker films. CVD thick film growth, its NV spin property, and resulting sensitivity and current measurement demonstrations will be described. For device applications, the MOS structure enabled control of NV charge states by applying an external bias voltage. Furthermore, by employing PIN junction device structure, electrical spin readout and NV emission could be achieved. This is a major step toward an all-electric NV control. Details and future prospective will be discussed including technical aspects peculiar to plasma CVD engineering of diamond NV centers. Acknowledgements: JPMXS0118067395, JPMJMS2062, JPMI00316.