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Tailoring of UNCD films with incorporated SiV centres

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Ultrananocrystalline diamond (UNCD) films incorporating photoluminescent color centres have emerged as promising materials for quantum sensing applications due to their unique optical properties. This study investigates the synthesis, characterization, and enhancement of silicon-vacancy (SiV) centres in UNCD films. We successfully fabricated variously Si-doped diamond films using microwave plasma chemical vapour deposition (MPCVD). To enhance the photoluminescence (PL) of SiV centres, we employed oxidation treatment, which resulted in increased PL intensity compared to as-grown samples. Additionally, we utilized molten salt thermal etching (MSTE) to create nanoparticles from UNCD film, resulting in selective etching of the graphite phase while preserving nanocrystalline diamond particles with SiV PL. Surface characterization of the as-grown samples using contact angle measurements with deionized water droplets confirmed their hydrophobic nature. In an effort to further enhance PL, we conducted preliminary experiments exploring the surface plasmon resonance (SPR) effect using gold nanoparticles. While initial results did not show PL enhancement under the conditions tested, this approach warrants further investigation to optimize the experimental parameters. Our findings demonstrate a multi-faceted approach to UNCD growth and modification, offering controllable porous character and SiV center concentrations, and pave the way for advanced quantum sensing applications.

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