Deactivation of NV^- color centers in glass-sandwiched diamond particles

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The nitrogen-vacancy (NV) color center in diamond has gained significant interest for quantum sensing due to its unique properties, in particular its magnetic field sensing capabilities at ambient temperatures [1]. Recently, hybrid diamond optical fibre based magnetic field sensing platforms have attracted significant attention for its potential in remote and distributed sensing capability [1, 2], where small diamond particles are embedded in the glass and distributed along the length of the fibre. Conventional methods used to create NV centers in diamond materials typically involve the use of ion implantation or electron beam irradiation followed by thermal annealing. Femtosecond laser writing techniques can also be used to create NV centres whin diamond [3]. Here, we introduce an alternative two-step approach which involves embedding irradiated diamond particles in glass in the first step and using a femtosecond laser to deactivate NV centers in regions where they are not required in step two. The deactivation of NV centers does not require as high laser pulse energy as the activation process and a large laser beam can be used to cover a wide area for rapid processing. We demonstrate our concept by deactivated pre-irradiated diamond particles sandwiched between two 1 mm thick glass (BK7) slabs Fig. 1(a). It can be seen that the NV fluorescence (pink fluoresecent dots appear in Fig. 1(b) is successfully suppressed in the laser written region Fig. 1(c). This research opens the potential for tailoring the concentration of fluorescent diamond within glass for quantum sensing applications.

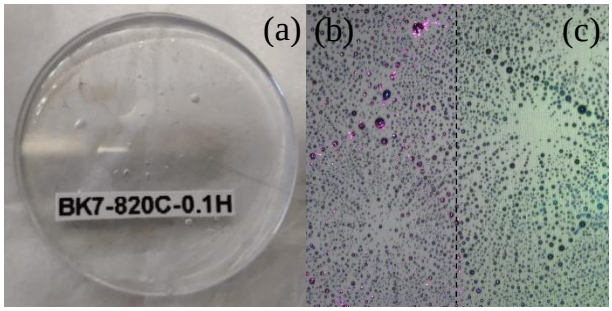

Fig. 1: femtosecond laser writing in sandwiched diamond glass

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[1] D. Bai, et al., *APL Materials* 8, 081102 (2020).

[2] S. Li, et al., *Optics Express*, Vol. 29, Issue 10, pp. 14425-14437 (2021)

[3] Y. C. Chen et al., Optica, vol. 6, no. 5, p. 662 (2019).