Fabrication at the speed of light: towards analyte-specific sensors made of diamond using UV laser as energy source

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Diamond is a biocompatible material of great interest in biosensing applications. For this purpose, the surface of chemically vapour deposited (CVD) diamond films is functionalised by physical and/or chemical methods to feature amine or acidic groups that serve as anchor points for biomolecules that will subsequently bind to specific enzymes, DNA or proteins. A common method is the anchoring of an unsaturated fatty acid, e. g., 10–undecenoic acid, which bears a double bond suited to react with the C–H groups on the diamond surface by means of a light-activated radical mechanism. Being an easy-to-access and practical option, benchtop UV lamps are typically used as the light source for this reaction. However, the time needed to achieve the reaction product in good yield and to cover the surface of the diamond films with the carboxylic acid is quite high, ranging from 12 to 20 hours.

In this work we demonstrate that the time needed to fabricate a functional carboxylate-decorated diamond surface can be reduced from several hours to a few minutes by using a laser source. An UV laser (248 nm wavelength) was used as the energy source for the reaction of 10–undecenoic acid with the diamond surface. The results were compared with the same reaction carried out using a plain 254 nm UV lamp. To help monitor reaction progress, the carboxylate moiety of 10–uncedenoic acid was decorated with a trifluoroethoxy appendix. The modified surfaces were characterised by contact angle, X-Ray Photoelectron Spectroscopy (XPS) and X-Ray Diffraction (XRD).