Laser induced periodic surface sructures on diamond in vacuum and air

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Diamond exhibits excellent physical properties and laser surface structuring of its surface can be considered for several applications, such as generation of black diamond for high-temperature solar cells, advanced optoelectronic platforms, THz flat optics, and so forth [1-4]. Surface functionalization of diamond can be achieved through the generation of laser induced periodic surface structures (LIPSS), which have been achieved by using either ns or femtosecond (fs) laser pulses [1]. In the case of fs laser pulse duration, previous reports have shown the formation of both low and high spatial frequency LIPSS [1,5].

Here, we report on the formation of LIPSS on CVD diamond generated through static irradiation of the sample with ~ 200 fs pulses at a wavelength of 1030 nm in air and vacuum environments. The processed samples were analyzed using Scanning Electron Microscopy, Atomic Force Microscopy as well as Raman spectroscopy.

Our findings address the effects of pulse number and energy on the features of the generated LIPSS, evidencing the differences in the formation process under the two different ambient conditions. By analyzing the variation of the fluence threshold with the pulse number, the effect of incubation will also be presented and discussed. Finally, a comparison between experimental results and model predictions will also be presented.

References:

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