Polarization effects on ultrafast laser ablation of diamonds

Krasin G K[1,@], Kovalev M S[1], Podlesnykh I M[1,2], Stsepuro N G[1] and Kudryashov S I[1]

[1] Lebedev Physical Institute of the Russian Academy of Sciences, Leninsky Avenue 53, Moscow 119991, Russia
[2] Bauman Moscow State Technical University, 2nd Baumanskaya Street 5, Moscow 105005, Russia

[@] krasin.georg@gmail.com

It is known that many parameters can affect the intra and inter center dynamics of charge carriers. Among them, one can note the pulse energy, the energy density, the pulse repetition rate and their duration, the wavelength [1]. However, there is one parameter, which is usually chosen randomly during experiments and this is the laser polarization. This often marginal parameter can play an essential role, when processing the crystals–materials with fixed crystallographic directions [2, 3]. This work describes the how the laser polarization state–or rather mutual orientation polarization azimuth and crystallographic plane–can affect the surface ablation of the natural diamond. The obtained azimuthal dependences exhibit distinct patterns, coinciding with specific crystallographic directions and corresponding bandgap widths in the Brillouin zone, and give enlightening picture on the dynamics of the processes happening during single-shot ablation of diamonds. The study can open the way for comprehensive modeling of the underlying novel ultrafast electronic and atomistic dynamics and laser energy deposition processes, which would be especially useful in development of ultrafast laser fabrication technologies.

[1] Balling P and Schou J 2013 *Reports on progress in physics* **76** 036502
[2] Krasin G, Kovalev M, Danilov P, Stsepuro N G, Oleynichuk E A, Bibicheva S A, Martovitskii V P and Kudryashov S I 2021 *JETP Letters* **114** 117–123
[3] Gertsvolf M, Jean-Ruel H, Pattathil R, Klug D, Rayner D and Corkum P 2009 *Physical review letters* **101** 243001