Surface engineering of polycrystalline diamond materials

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Surface treatment of metals and alloys via laser processing has been a successful technique adopted in various industrial sectors to improve the materials' mechanical properties. Among surface treatments techniques, laser shock processing with/without coatings has been found promising to allow for functionality to be applied to materials through a change in the surface topography. Research in the area of laser shock processing of diamond materials with/without coating is still scarce and requires an in depth understanding on the effect of the processing parameters on the achieved properties. The current work is focused on low energy laser shock processing with/without coating of two different grades of PCD using a 1064 nm wavelength single mode SPI redENERGY G4 pulsed fibre laser. A range of laser conditions such as power intensity, feed speed, frequency and waveform are investigated to understand the effect of light distribution and fluence/energy density on the laser spot size. Surface modifications such as surface roughness, hardness, and microstructure of the PCD grades are investigated before and after laser processing and compared to the as-received benchmarked material. A 3D white light interferometry (Alicona InfiniteFocus), scanning electron microscopy and NanoTest system equipped with Berkovich indenter are used to characterise the pre and post processed materials. The samples processed using low-energy shock processing revealed a 35% increase of micro hardness in comparison to the as-received samples. This work is a step towards the development of low energy processing techniques whilst characterising the laser process parameters to surface treat PCDs.