The use of sub-picosecond laser processing for producing surface structures/textures on diamond-like carbon coated replication masters

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Diamond-like carbon (DLC) is an amorphous form of carbon containing a significant fraction of sp^3 bonding. It possesses very good mechanical and tribological properties such as high hardness and high wear resistance and additionally it exhibits good chemical inertness. These desirable properties make DLC a coating material suitable for a number of applications, namely magnetic storage disks and micro-electromechanical devices amongst others. Due to their low surface roughness and low friction coefficient, DLC thin films are used as solid lubricants in moulds for injection moulding, too. One of the main issues associated with DLC is its difficulty to process and structure/texture without altering its attractive properties. Therefore, sub-picosecond laser processing is investigated in this research as a non-invasive solution for processing this otherwise difficult to structure/texture material. Laser processing of DLC coatings can be performed both at micro and sub-micron scales, namely by producing laser induces periodic surface structures (LIPSS). In this research, the effects of sub-picosecond laser processing on DLC coatings' properties is investigated. X-ray diffraction measurements were performed to determine the changes in the crystallisation level of the coating after laser irradiation with different processing parameters. Additionally, the evaluation of structure fractions of sp^2 and sp^3 bonding was carried out with Raman spectroscopy. Finally, tribological tests and hardness measurement were performed to determine and compare the mechanical properties of laser texture DLC surfaces. Conclusions are made about the effects of sub-picosecond laser processing on the DLC coatings' properties, especially as one-step approach for producing desirable surface structures/textures on replication masters.