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PHOTOABLATION OF MATERIALS USING U.V. LASER RADIATION

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When a laser beam is focussed onto the surface of a material, for high fluence values, it is well known that material may be strongly ejected leading to the formation of a "plume" above the surface. This phenomenon frequently called photoablation has numerous applications and particularly, micro-machining or etching of the target and deposition of thin films will be particularly considered. Though photoablation may be performed with various type of lasers, the use of U.V. laser radiation (excimer lasers) is of particular interest for several applications because well chosen experimental conditions can lead to low thermal-induced phenomena within the target bulk and to congruent evaporation of the target material. These characteristics have stimulated numerous works these last past years, but according to the complexity of the involved processes, photoablation and particularly transport phenomena within the plasma plume, are still far to be well understood, though these processes play a dominant role in micro-machining and in thin films deposition.

These phenomena have been extensively studied in our laboratory these last past years. In this paper we present particularly our results concerning KrF laser-induced photoablation of polymers and ceramic materials. The plasma plume is investigated using mainly time-resolved (<2 ns) high resolution (<0.01 nm) spectroscopy and mass spectrometry. These measurements allow the determination of various parameters of the plasma plume such as : nature of species, temperature within the plasma plume, "flow velocity" of the ejected species, influence of the nature and the pressure of the ambient atmosphere etc... . These experimental investigations have been done for various target materials : polymers (PMMA), ceramics (Al₂O₃; ZrO₂; Si₃N₄) and high T_c superconducting materials. The results will be presented and discussed in terms of models of description. From these works, some applications have been developed in the fields of micro-machining of polymers and ceramics and of deposition of thin superconducting films, results concerning these applications will be also presented and discussed.

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