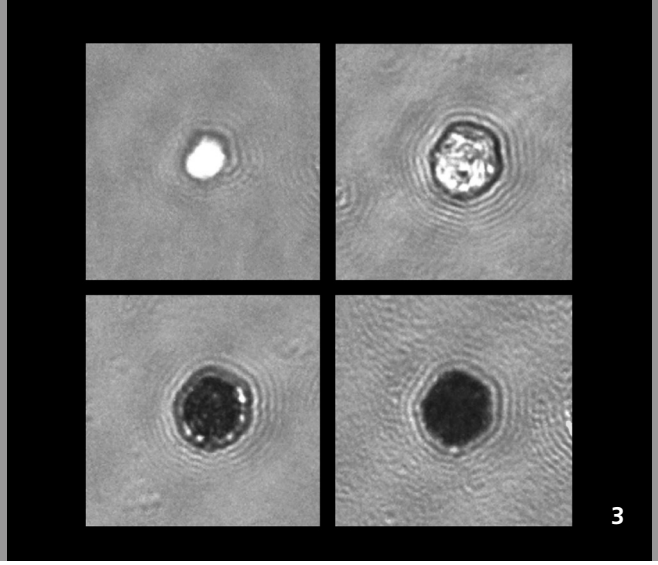

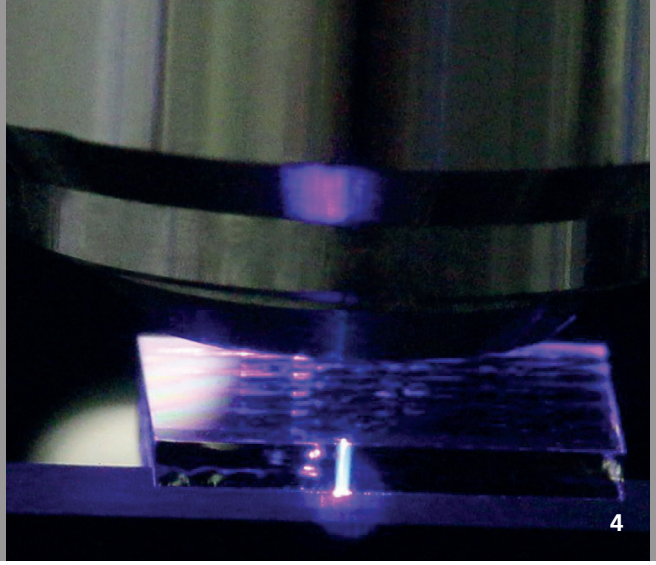

PUMP-PROBE MICROSCOPY OF PROCESSING GLASS WITH ULTRASHORT PULSED LASER RADIATION

Task

Due to the high intensity of ultrashort pulsed laser radiation, even transparent glass can be processed. When these materials are processed, however, non-linear interaction processes, such as the Kerr effect or plasma defocusing, play a central role. These effects eventually lead to material defects such as cracks, which are problematic for final applications. It is, therefore, a major challenge today to control the deposition of the laser pulse energy in the material and, consequently, to process with ultrashort pulsed laser radiation without generating defects. At the same time, controlled processing offers enormous potential for many applications, in particular for the production of displays. An understanding of process dynamics with high temporal resolution is required to guarantee that these interaction processes can be described and manipulated in a controlled manner.

Method

So that the absorption of laser radiation can be examined in the material with high temporal resolution, in-situ coaxial reflection measurements are performed using pump-probe measurement technology. Since it has a temporal resolution of about 100 fs, the interaction processes can be analyzed with high resolution.

Result

The reflection of the irradiated surface increases within the first 10 ps, which can be explained by the generation of a large number of free electrons and the resulting metal-like properties of the glass. From about 12 ps, the reflection is reduced or the absorption of the glass surface increases due to an onsetting ablation mechanism.

Applications

Understanding the fundamental process dynamics makes it possible to process glass defect-free with temporally tailored pulse shapes. The process can be used, in particular, for the production of glass in the electronics industry.

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3 Time-resolved reflection of an irradiated glass surface.
4 Pump-probe setup.