CHANGES IN AMORPHOUS SILICA MECHANICAL PROPERTIES INDUCED BY FEMTOSECOND LASER IRRADIATION

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Femtosecond laser irradiation is an efficient process to modify refraction index of silicate glasses in order to create waveguide in glass fibers. Depending pulse energy and pulse duration, different kind of modifications can happen such as densification to nanoporosity nucleation [1], which affects optical properties in different ways. However such modifications should also affect mechanical properties and could be prejudicial to glass durability. The aim of this paper is to investigate effects of femtosecond laser irradiation on mechanical properties of silica glass using nanoindentation and micropillar compression [2]. For that purpose linear waveguides are produced using different process parameters. Samples are cut perpendicular to these waveguides. Nanoindentations are performed on the resulting cross-sections. Pillars are fabricated using a FIB and are then compressed using a specific nanomechanical tester.

Main results are presented on Fig 1. It is shown that the highest irradiation energy lead to decrease in mechanical properties. This effect is more pronounced with micropillar compression than with nanoindentation. This can be explained by the highest hydrostatic pressure in indentation experiments, which can limit damage of silica.

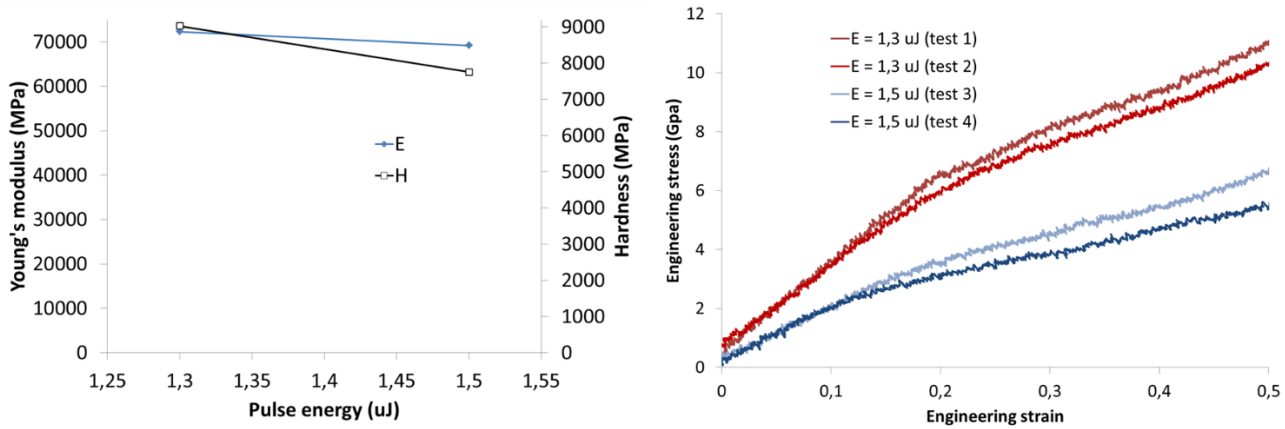

Figure 1 : Left - nanoindentation results, hardness decreases with pulse energy. Right: micropillar compression test, yield stress and elastic modulus decrease with pulse energy.

References :
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