Realization of a MEMS Resonator for the Investigation of Femtosecond Laser-Fused Silica Interaction.

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Introduction

Ultrafast laser micro-machining technologies make use of non-linear absorption phenomena to modify transparent materials, like glass. These effects are triggered by tightly focusing pulsed laser beam, with pulse durations in the pico- or femto-second range. The power intensity in the focal point can be extremely high, in the range of 100 GW/mm². Due to the rapid deposition of energy during a ultrashort time period, a mechanical shock-wave is launched and propagates through the material. Furthermore, after this fast transient event, structural changes in the glass matrix are observed causing a change in the material mechanical properties. In this thesis, using the intrinsic stiffness sensitivity of MEMS resonators, we explore both temporal and structural changes resulting from this laser-matter interaction.

MEMS Resonator

Our MEMS resonator is based upon an electrostatically driven tuning fork. Such resonators can reach high quality factors, since the anti-phase mode of the tuning fork structure reduces the support losses.

Experimental setup

To perform an in-situ measurement, an experimental setup is designed and realized. The MEMS-resonator is exposed to femtosecond laser inside a medium-vacuum chamber. An optical measuring line is developed, to measure the resonator response during the exposure.

Final remarks

In this thesis work there is no proof of concept demonstrated of the proposed measuring principle. However the setup is nearly ready for such dynamic measurements.