Master's 2nd year internship

Stress Measurement Techniques in Silica Glass Using Photoelasticity

Laboratory: LP3, Campus de Luminy, Marseille 13009, France
Advisors: Alexandros Mouskeftaras – CNRS researcher (alexandros.mouskeftaras@cnrs.fr)
Finance: ~630 €/month (net)
Duration: 6 months with **Flexible Starting Date** (~1st Semester 2025)
Keywords: Photonics, Material Science, Optical Diagnostics

Description: Femtosecond lasers are commonly used today to process a wide range of materials with optimal quality. Transparent solids, in particular, have attracted attention due to increased demand for display devices. Reinforced glass cutting for smartphones is a common application. However, during laser processing, stress can build up, leaving behind weakened material with reduced mechanical resistance, which can lead to failure under certain circumstances.

At LP3, we study the interaction of femtosecond laser pulses with silica glass using optical diagnostics[1]. The ability to measure stress accurately in silica glass is crucial for preventing material failures in applications like smartphone displays. A well-established technique for measuring laser-generated stress is quantitative photoelasticity, which offers high precision. Isotropic materials such as glasses become optically anisotropic when subjected to stress. Measuring stress-induced birefringence (retardance and slow-axis orientation) provides valuable information on the difference in principal stresses and their orientation. Various configurations and retardance/slow-axis orientation retrieval algorithms can be used to optimize speed or sensitivity.

During this internship, we propose benchmarking these stress measurement solutions on a known stress case (e.g., glass beam bending or glass sphere compression) using incoherent illumination (Light-Emitting Diode). First, an existing phase-shifting circular polariscope will be tested with different retrieval algorithms. Next, a polarization camera will be used to acquire simultaneous polariscopic data increasing acquisition speed. Finally, single-shot laser damage spots will be analyzed for surrounding stress with high spatial resolution.

The focus of the internship will primarily be on experimental work and data collection. However, depending on the student's progress and interests, there may be opportunities to explore additional configurations and methods. The project will help the student develop strong experimental skills while working on a critical issue in material science.

Acquired Competencies: Hand-on experience in optics, Optical instrumentation, Interfacing & Automation, Optical Metrology

1. Koritsoglou, O., Duchateau, G., Utéza, O. & Mouskeftaras, A. Quantitative assessment of femtosecond laser-induced stress waves in fused silica. *Phys. Rev. B* **110**, 1–11 (2024).