K 2: Gas dynamics – Laser Systems and Laser Applications

Time: Monday 14:00–15:20 Location: ELP 6: HS 1

K 2.1 Mon 14:00 ELP 6: HS 1

Experimentelle Untersuchungen zu Stoßwellen in Mikro-Stoßrohren mit idealen und realen Gasen — •Lars Jepsen[1], Walter Garen[1] und Ulrich Teubner[1,2] — [1]Hochschule Emden/Leer, Institut für Laser und Optik — [2]Carl von Ossietzky Universität Oldenburg, Institut für Physik

Stoßwellen spielen in vielen Gebieten der Physik und Technik eine wichtige Rolle. Für sehr dünne Stoßrohre (D_{hyd} < 200μm) wächst die Grenzschichtdicke auf die Größenordnung des Stoßrohrquerschnittes an, wohingegen in Makro-Stoßrohren ($D_{hyd} \approx$ 50mm) der Grenzschichteinfluss oft vernachlässigbar ist. Theoretische Modelle für Mikro-Stoßrohre erfordern daher zusätzliche Informationen der Strömungsform z.B. von geeigneten Kennzahlen.

Es werden ideale Gase in Mikro-Stoßrohren untersucht. Ein schnelles Mikroventil erzeugt bei voreingestellten Treiber- und Testgasdrücken eine Stoßwelle mit nacheilender Kontaktfläche. Eine interferometrische Messung der zeitlichen Dichteänderung am Messort entlang der Stoßachse liefert Informationen über die zeitliche und lokale Stoß- sowie Kontaktflächenausbreitung unter Reibungseinfluß.

Ein weiteres Experiment beschäftigt sich mit der Ausbreitung von Stoßwellen in realen Gasen mit Grenzschichtkondensation an der Oberfläche des aus Glas bestehenden Stoßwellenrohres. Die zeitliche Entwicklung der Kondensationsschichtdicke auf der Rohrinnenwandung wird mit einem Laserreflexionsinterferometer gemessen und liefert die Kondensationsschichtdicke als Funktion der Zeit, die besonders in Mikro-Stoßrohren wichtige Hinweise auf die Strömungsform gibt.

K 2.2 Mon 14:20 ELP 6: HS 1

Parameter study on single-pulse femtosecond laser irradiation of single-crystalline silicon — •Andy Engel, Theo Pflug, Markus Olbrich, Philipp Lungwitz, and Alexander Horn — Laserinstitut Hochschule Mittweida, Hochschule Mittweida, 09648 Mittweida, Germany

In this study single-pulse irradiation of single-crystalline, <111> -oriented silicon is investigated by varying the fluence of the applied ultrashort pulsed laser radiation (pulse duration 40 fs, wavelength 800 nm). The resulting irreversible material changes due to the laser radiation-matter interaction are presented and discussed. The spatially resolved spectral refractive index was determined by ex situ ellipsometry. Comparative analyses of the topography of the irradiated surfaces were performed using confocal laser scanning microscopy and atomic force microscopy. The combination of the measured data with optical models and simulations allows a more accurate description of the physical processes induced by pulsed laser irradiation, starting with changes in crystallinity up to ablation. Additional information about the depth of the thermally induced material phase changes have been obtained by downstream wet chemical etching.

K 2.3 Mon 14:40 ELP 6: HS 1

17 GHz monolithic self-starting Kerr-lens mode-locked Titanium-Sapphire laser — •Torben Fiehler and Ulrich Wittrock — Photonics Laboratory, FH Münster, Stegerwaldstraße 39, 48565 Steinfurt, Germany

Ultrafast lasers with pulse repetition rates in the multi-GHz regime are of interest for applications in frequency metrology, dual-comb spectroscopy, calibration of astronomical spectrographs, microwave generation, and telecommunication.

We present a monolithic self-starting soft-aperture Kerr-lens mode-locked Titanium-Sapphire (Ti:Sa) laser that generates 204 fs pulses at 812 nm with 900 mW average power and a pulse repetition rate of 16.9 GHz. This is the highest repetition rate for a fundamentally mode-locked Ti:Sa laser. Moreover, our laser is the first monolithic mode-locked Ti:Sa laser. It consists of a 5 mm thick plane-parallel Ti:Sa disk where both surfaces bear dispersive mirror coatings. This plane-plane resonator is stabilized by the thermal lens that is generated by the pump power. Reliable self-starting soft-aperture Kerr-lens mode-locking sets in at an absorbed pump power of 1.8 W which corresponds to 700 mW of average mode-locked laser power. At 900 mW, the frequency comb has a spectral bandwidth of 4 nm and about 300 modes resulting in about 5 mW per mode in average. Mode locking is maintained up to an absorbed pump power of 2.6 W and 1100 mW average laser power. Above this power, mode locking becomes unstable.

K 2.4 Mon 15:00 ELP 6: HS 1

High-precision processing of technical glass using a combination of pulsed laser ablation and plasma jet processing at atmospheric pressure — •Martin Ehrhardt[1], Robert Heinke[1,2], Pierre Lorenz[1], Thomas Arnold[1,2], and Klaus Klaus Zimmer[1] — [1]Leibniz Institute of Surface Engineering, Leipzig, Germany — [2]Technische Universität Dresden, Germany

One ultra-precision surface processing technique is non-thermal atmospheric reactive plasma jet etching (PJE). PJE uses reactive plasma interaction to remove material from substrate surfaces by converting it to volatile or gaseous substances. Technical glass is made from a variety of materials, including metal oxides. These metal oxides form non-volatile compounds during plasma jet etching that leave a residue layer after processing.Residue layers lead to self-masking and create a barrier that prevents further material removal. It has been shown that this problem can be solved by combining PJE and laser ablation. In the current study, the interaction between PJE-treated technical glass surfaces and pulsed laser radiation is investigated in detail. SEM, EDX and XPS will be used to examine the surfaces after PJE and subsequent laser ablation.