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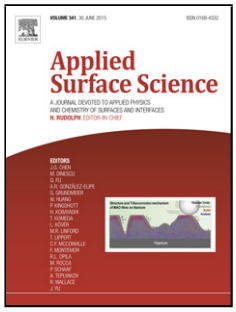

Title: Investigation of Diffractive Optical Element Femtosecond Laser Machining

Author: Grégoire R. Chabrol Adline Ciceron Patrice Twardowski Pierre Pfeiffer Manuel Flury Frédéric Mermet Sylvain Lecler

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Highlights:

- A method for rapid manufacturing of optical diffractive element in BK7 is proposed.
- A binary grating in BK7 was successfully machined by femtosecond laser pulses.
- Process relying on nonlinear absorption in the dielectric due to photoionisation.
- The binary grating was analysed by SEM and interferometric microscopy.
- Simulations by Fourier Modal Method supported the measured diffractive efficiency.

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Authors: Grégoire R. Chabrol[1, 2, *], Adline Ciceron[1, 2], Patrice Twardowski[2, 3], Pierre Pfeiffer[2, 3], Manuel Flury[2, 4], Frédéric Mermet[5], Sylvain Lecler[2, 3]

1) ECAM Strasbourg-Europe, Espace Européen de l'entreprise, 2, rue de Madrid - 67300 SCHILTIGHEIM, CS. 20013 – 67012 Strasbourg CEDEX, France

2) Laboratoire des Sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (ICube), UDS-CNRS, UMR 7357, 300 bld Sébastien Brant, CS 10413, 67412 Illkirch cedex, France

3) Télécom Physique Strasbourg - Pôle API - 300 Bd Sébastien Brant - CS 10413 - F 67400 ILLKIRCH GRAFFENSTADEN, France

4) INSA de Strasbourg, 24 bld de la Victoire, 67000 Strasbourg, France

5) IREPA LASER, Parc d'Innovation, 67400 Illkirch, France

* Corresponding author: g.chabrol@ecam-strasbourg.eu

Phone: +33 (0)6 03 00 64 90

Abstract:

This paper presents an explorative study on the machining of Diffractive Optical Elements (DOEs) in transparent material using a femtosecond laser source. A simple form of DOE, a binary phase grating with a period of 20.85 µm (σ = 0.5 µm), a groove depth and width of 0.7 µm (σ = 0.2 µm) and 8.8 µm (σ = 0.5 µm) respectively, was successfully machined in BK7. The topographic characteristics were measured by white light interferometry and Scanning Electron Microscopy (SEM). The processing was carried out on high precision stages with an ultrafast fibre laser (350 fs) emitting a 343 nm pulse focused onto the sample with a stationary microscope objective. A diffracted efficiency of 27 %, obtained with a spectro goniometer, was corroborated by the theoretical results obtained by the Fourier Modal Method (FMM), taking into account the measured topographic values. These encouraging results prove that high-speed femtosecond laser manufacturing of DOE in bulk glasses can be achieved, opening the way to rapid prototyping of multi-layered-DOEs.