



**HAL**  
open science

# First demonstration of type A volume Bragg grating for the VIS-NIR applications

Joelle Harb, Lauris Talbot, Martin Bernier, Yannick Petit, Lionel Canioni

## ► To cite this version:

Joelle Harb, Lauris Talbot, Martin Bernier, Yannick Petit, Lionel Canioni. First demonstration of type A volume Bragg grating for the VIS-NIR applications. SPIE Photonics West - SPIE LASE: "Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XXIII", International Society for Optics and Photonics, Jan 2023, San Francisco, Californie, United States. hal-04599395

**HAL Id: hal-04599395**

**<https://hal.science/hal-04599395v1>**

Submitted on 13 Jun 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# First demonstration of Type A Volume Bragg Grating for the VIS-NIR applications.

Joelle Harb, Lauris Talbot, Martin Bernier, Yannick Petit, Lionel Canioni.

Volume Bragg gratings (VBG) have become a hot research topic in optical applications with emphasis in the NIR range. So far, Volume Bragg gratings are commonly fabricated in photo-thermo-refractive glasses using UV light or also in various materials such as fused silica, borosilicate, PMMA, chalcogenide, fluoride glasses using infrared femtosecond laser writing. The photoinscription of VBGs can be realized by using either the scanning phase-mask technique exhibiting a high period stability or a Bessel beam that produces a larger modification length aiming to limit the number of planes and allowing for chirp or entangled VBGs applications. Mainly type 1 refractive index modification is reported as the main mechanism for inscribing VBGs in those materials.

To our knowledge, we report the first demonstration of type *A* laser modification for VBG in silver-containing glasses by femtosecond laser writing. Type *A* high refractive index modification is supported by the laser-inscribed silver clusters, having the ability to produce tiny feature down to hundred of nanometers with weaker laser intensity. Hence, this is well adapted for high throughput in the VBG writing process. We present a comparative study between different approaches to achieve high diffraction efficiency in VBG for the VIS-NIR range. The first approach involves direct writing, line-by-line, and plane-after-plane, of the entire structure with a Gaussian beam as well as a Bessel beam. The second method will be considered with the inscription under a periodic phase mask. This work opens the avenue for femtosecond writing VBGs with high throughputs compatible for industrialisation.

## 100 word summary:

We report on the first demonstration of Volume Bragg grating (VBG) by femtosecond laser writing in silver-containing glasses using type *A* high refractive index modification supported by the laser-inscribed silver clusters. We present a comparative study between different approaches to achieve high diffraction efficiency in VBG for the VIS-NIR range. The first approach involves direct writing, line-by-line, and plane-after-plane, of the entire structure with a Gaussian beam as well as a Bessel beam. The second method will be considered with the inscription

under a periodic phase mask. This work opens the avenue for femtosecond writing VBGs with high throughputs compatible for industrialisation.