Institut des Nanotechnologies de Lyon UMR 5270

http://inl.cnrs.fr

Master II internship

Development of grayscale lithography for high efficiency blazed gratings on convex surfaces

Research group: i-Lum team & Nanolyon platform at INL, in Lyon
Location: INL UMR CNRS 5270 – La Doua, Villeurbanne
Skills: Direct laser Lithography , AFM, SEM
Profile: Micro-Nanoscale Engineering
Duration: 6 months

Project

Context: In the frame of a collaboration between the Astrophysics Laboratory of Marseille (LAM), the Light Mater Institute of Lyon ILM) and the Lyon Institute of Nanotechnology (INL), a master2 internship position is open for a duration of 6 months. This collaborative project aims at developing an innovative technological solution for manufacturing high efficiency blazed gratings on convex surfaces for advanced next-generation space instruments. This grating is a key component for reaching unprecedented performance in spectroscopy. Blazed grating exhibits excellent optical characteristics because it can concentrate light energy at a specific diffraction order through diffraction plane leading to specific blaze angle. The blazed grating and the optical path of its diffraction are depicted in Figure 1. To design and fabricate this kind of pattern, it exists different options, we propose an original process using **GrayScale Lithography** (GSL) on a commercial resist. By leveraging advanced microfabrication techniques such as GSL and plasma etching in convex surface, the study seeks to overcome current limitations in diffraction mirror for astronomical instrument applications.

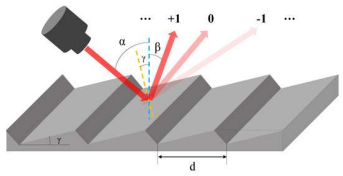

Figure 1 Schematic and optical path diffraction of a blazed grating [M

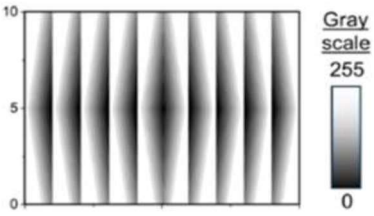

Figure 2 Grey scale file

Work: During the internship, the student will develop the technological process for writing first a grayscale 1D structure on flat surface according to a GDS design file edited using python programing (as represented on figure 2). In order to qualify the technological results, morphological characterizations (SEM, AFM) will be performed. Back-and-forth comparisons between these characterizations and the lithography results will enable the expected parameters to be adjusted in terms of geometry: periodicity, height, blaze angle, roughness… After this initial study to adjust the resin parameters to meet the requirements of the blazed grating implemented on a lens, the student will develop a process for writing grayscale structure on a convex surface. As the lithography system allows an automatic focus adjustment, the student will be asked to adjust designs to reproduce the array on a convex substrate provided by LAM.

Depending on the progress of the results, the student may be required to develop plasma etching processes for transferring patterns onto glass and reach the most advanced manufacturing processes which have shown roughness values in the order of 10 nm.

Realized prototypes will then be tested at LAM in terms of diffraction efficiency with respect to wavelength, polarization dependence and straylight measurement.

Profil: The subject is exploratory and requires rigorous technological work and a motivation in technological development. The candidate must demonstrate initiative and autonomy in order to successfully complete this challenging work.The master student will collaborate with the INL engineer permanent staff and ILM and LAM researchers. As the nature of the proposed work is mainly experimental, the candidate must have experience/knowledges in micro-nano-technologies and characterizations methods mainly SEM and/or AFM.

Contacts: celine.chevalier@insa-lyon.fr
nicolas.terrier@insa-lyon.fr
alban.gassenq@univ-lyon1.fr
frederic.zamkotsian@lam.fr