PhD Proposal:

Engineering light scattering in optical interference coatings

Advances in deposition technologies have increased the complexity of interference filters and today meet new stringent requirements. In this context, light scattering, and more particularly wide-angle scattering, is proving to be a lock for a number of applications concerning integrated demultiplexing. Numerous efforts have been made to modify or reduce wide-angle light scattering, with some success. These efforts concerned theoretical, metrological and technological aspects.

In particular, considerable progresses were achieved in the field of metrology to measure light scattering patterns (BSDF) with 8 decades of detectivity over a wavelength continuum (400-1000nm, SALSA instrument). This unique result was obtained thanks to the support of CNES, and clearly brings Fresnel Institute at the forefront of the international scene. This is evidenced by a growing number of solicitations by major companies in the field (Zeiss, VIAVI Solutions, CILAS, ADS, Safran REOSC, Iridian ...) and other major organizations such as ESA. Finally, Fresnel Institute is now an active member of the AFNOR / ISO concerning light scattering metrology. In addition, the laboratory is currently supported by CNES to extend the SALSA instrument to near infra-red (950nm-1.7µm) by the end of 2018.

However though the metrological tools are now extremely advanced, a major demand raises to control scattering both in the fine understanding of its mechanisms and in the extraction of the parameters which govern these mechanisms: roughness spectra, cross-correlation laws, indices and thicknesses, localized defects ... This thesis work will take place in this context, the first objectives of which are as follows:

First, all calculation has been carried out under assumptions of high interface correlation, which must now be checked with great accuracy. To solve this recurring inverse problem, we propose to implement robust and systematic procedures to extract the cross-correlation laws of optical multilayers, which are responsible for mutual coherence of the waves scattered by inhomogeneities in different layers. The procedure will first rely on experimental data, that will be analyzed through an equation system taking into account the weight of inhomogeneities and excitation currents in the whole wavelength continuum.

2. Another key expected progress concerns the multilayer design itself. We must now analyze the coatings in the complex plane by emphasizing their distribution of poles and zeros, which are responsible for large-angle scattering lobes. These scattering poles will also be linked to the poles that govern the specular optical properties, thus opening new ideas to position or control the diffusion lobes.

3. For an oblique illumination incidence, the out of plane scattering behavior is rarely addressed due to the lack of symmetry and to the increased numerical complexity. The third point proposed here is to modify this balance by optimizing the calculation codes for oblique incidence and turn it to an added value.

4. Finally, the design formulas identified as relevant will be completed, produced and measured for feedback on the models.

Candidate profile :

The candidate must have a master's degree in physics or an engineering school diploma. The work to be done will present theoretical, numerical and experimental aspects to be carried out in parallel. The candidate must therefore present a certain interest for these different approaches of Physics, and Optics in particular. Basic training in optics is desirable.

Fundings :

CNES / Industry : The PhD student will be hired by the CNES in mission at the Institut Fresnel from November, 1, 2018.

Hosting Laboratory :

Institut FRESNEL, Domaine Universitaire de Saint Jérôme, 13013 MARSEILLE, FRANCE

CONCEPT Group : www.fresnel.fr/concept

Supervisors :

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CNES Responsible :

Karine MATHIEU, Optic Department, CNES, Toulouse

APPLICATION DEADLINE : MARCH ,5th, 2018

Send resume, cover letter and M1 and M2 transcripts to myriam.zerrad@fresnel.fr