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# Light scattered by high performance optical components: Numerical prediction and accurate metrology

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Light scattering issues specific to high performance optical components have received considerable attention over the last decade for several reasons.

Firstly, the manufacturing processes of interference filters have benefited from technological breakthroughs which today allows the routine manufacture of stacks with several hundreds of thin films on substrates with extreme polishes. Such complexity leads to a high increase of scattering phenomena which originate from all interface roughnesses of the coating.

In addition, the specifications for Space applications have become more severe, especially in the development of hyper-spectral micro-imagers (in the form of arrays or pixels). Crosstalk rates and scattering lobes at large angles of the interference filters have become the key to the performances of these components.

Finally, the success of the detection of gravitational waves has brought the mirror requirements to the forefront, including light scattering.

In this context, the Light Scattering Group of the Institut Fresnel has met several scientific challenges that were not addressed until now. These challenges fall into two main areas:

**Extreme instrumentation for low-flux metrology** with the development of metrology tools aimed at quantifying the scattering budgets of low-loss optical components while discriminating the effects (surface vs. volume, defects vs. roughness, spectrally, spatially and angularly resolved metrology, etc.)

**Modelling and control of light scattering in optical surfaces and coatings** with the numerical implementation of electromagnetic models allowing the accurate prediction of fields scattered from stacks of "complex" optical thin films and the use of neural networks for the synthesis of stacks based on a light scattering criterion.

For each of these areas, we will present the issues related to space applications as well as the main theoretical, numerical and instrumental developments carried out by the Light Scattering Group of the Institut Fresnel.

References


1. *C. Amra, M. Lequime, M. Zerrad. Electromagnetic Optics of Thin-Film Coatings: Light Scattering, Giant Field Enhancement, and Planar Microcavities. Cambridge University Press, 2020, 9781108772372.*
2. *M. Fouchier, M. Zerrad, M. Lequime, C. Amra. Wide-range wavelength and angle resolved light scattering measurement setup. Optics Letters, - OSA Publishing, 2020, 45 (9), pp.2506-2509*
3. *I. Khan, M. Lequime, M. Zerrad, C. Amra. Detection of Ultralow Light Power Back-Reflected or Back-Scattered by Optical Components Using Balanced Low-Coherence Interferometry. Phys.Rev.Applied, 2021, 16 (4), pp.044055.*
4. *M. Zerrad, M. Lequime, S. Liukaityte, C. Amra. Parasitic light scattered by complex optical coatings: modelization and metrology. CEAS Space Journal, Springer, 2017,*
5. *M. Lequime, M. Zerrad, C. Deumie, C. Amra. A goniometric light scattering instrument with high-resolution imaging. Optics Communications, Elsevier, 2009, 282, pp.1265-1273.*

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