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PIXELATED COATINGS AND ADVANCED IR COATINGS

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Abstract: *Reosc developed pixelated infrared coatings on detector. Reosc manufactured thick pixelated multilayer stacks on IR-focal plane arrays for bi-spectral imaging systems, demonstrating high filter performance, low crosstalk, and no deterioration of the device sensitivities. More recently, a 5-pixel filter matrix was designed and fabricated. Recent developments in pixelated coatings, shows that high performance infrared filters can be coated directly on detector for multispectral imaging. Next generation space instrument can benefit from this technology to reduce their weight and consumptions.*

Reosc developed for decades, advanced infrared coating for military and space applications. From MIPAS, Helios, Rosetta, MSG, IASI, to more recently MTG and IASI-NG, Reosc contributed to the major space programs, providing dedicated infrared optics.

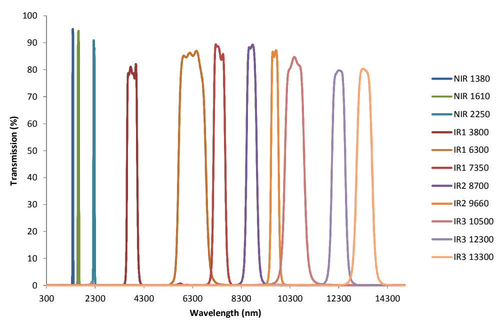

Fig.1: MTG Filter set manufactured by Reosc

High end applications in infrared detection benefit from colorimetry. Current multispectral imaging systems either use filter wheels to detect one spectral band at a time, or complex optics that separate the incoming light flux into multiples optical paths, each corresponding to a spectral band of interest. As a result, these systems are bulky, sensitive to stray light, and are not all suitable for real-time acquisition. Besides, infrared (IR) photodetectors often suffer from signal loss at the air/detector interface, due to low performance antireflection coating (ARC).

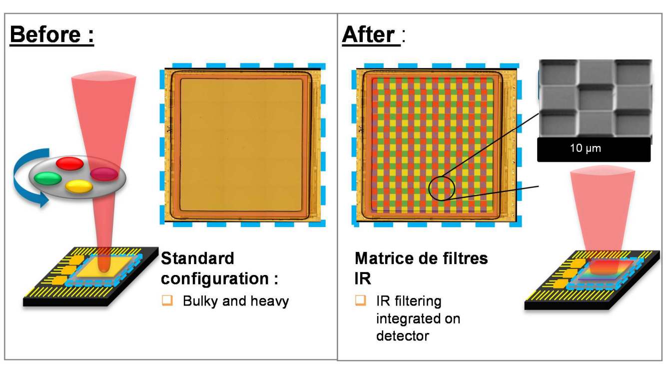

Fig.2: Innovation of pixelated infrared filters on detector

Such issues are significantly reduced when the multispectral filtering is performed at detector level. Compared to the conventional imaging systems described above, a multispectral camera comprising individual filtering elements deposited on the detector surface can achieve higher compactness, lower flux loss at the interface, as well as real-time acquisition. Technological constraints appear when manufacturing pixelated filters directly on a photodetecting device. The complex spectral responses required for space and defense applications can only be achieved by interference filters with typical thicknesses of 3-20 µm with a nanometer precision on the layer thicknesses. Therefore, structuring these multilayer stacks down to the pixel pitch (down to10 µm) requires state-of-the-art microfabrication techniques. Also, both the coating and the patterning process might degrade the photodetecting device sensitivity.

Reosc, with its unique expertise in IR thin film coating, was able to manufacture thick pixelated multilayer stacks on IR-focal plane arrays (IR-FPA) for bi-spectral imaging systems, demonstrating high filter performance, low crosstalk, and no deterioration of the device sensitivities. Current developments are aimed at improving the patterning process to ensure the pixel uniformity and reduce the pixel size down to 10 µm. Additional work was also carried out on a patterning process for multispectral Fabry-Pérot filters. The critical issue is the precise control over the cavity thicknesses, which governs the transmission peak wavelength.

A bi-spectral IR-FPA photodetector was designed and fabricated for detection in the SWIR-MWIR range. The multilayer stacks were designed in order to reach the performance level of standard IR optics (i.e. T>95% and T<0.1% on the specified bands). The total thickness of the stack (including both filters) is >10 µm.

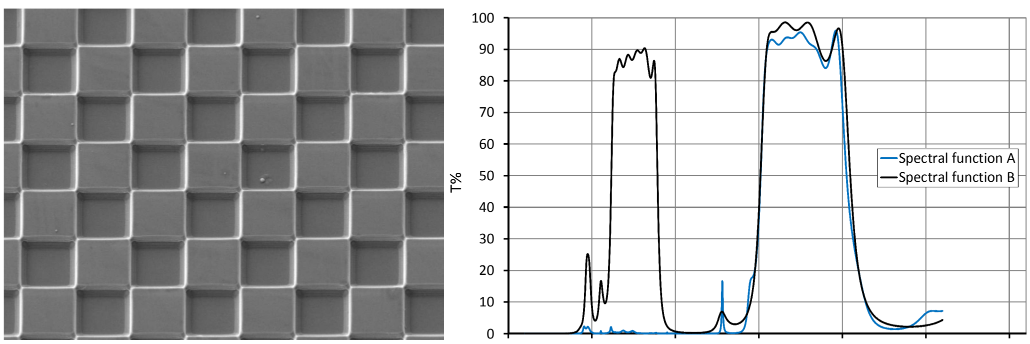

Fig. 3: SEM view of the patterned IR-FPA.

More recently, a 5-pixel filter matrix was designed and fabricated.

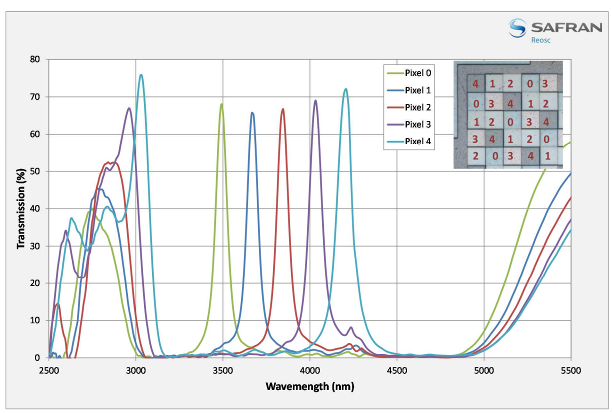

Fig. 4: 5-pixel filter matrix spectral response

Recent developments in pixelated coatings, shows that high performance infrared filters can be coated directly on detector for multispectral imaging. Next generation space instrument can benefit from this technology to reduce their weight and consumptions. Our ambition is to propose, in a near future, a broad set of solutions for multispectral IR real time imaging systems.