Recent development on dual-band uncooled PbSe sensors monolithically integrated on advanced interference filters

Plaza del Olmo, Julio[1], Torquemada Vico, María del Carmen [1]; Rodrigo Rodríguez, María Teresa[1]; Gómez Zazo, Luis Jorge[1]; Villamayor Callejo, Víctor[1]; Fernández Gutiérrez, David[1]; Almazán Carnero, Rosa María[1]; Sierra Asensio, Cristina[2]; Génova Fuster, Inés[2]; Catalán Fernández, Irene[2]; Gutiérrez Martín, Clara[2]; Álvarez García, Mario[2]; Magaz Pérez, María Teresa[3]

[1] Instituto Tecnológico la Marañosa (ITM), Madrid, Spain
[2] Ingeniería de Sistemas para la Defensa de España (ISDEFE)
[3] New Technologies Global Systems (NTGS), Madrid, Spain

jplazao@oc.mde.es

PbSe detectors are photoconductors with optimum response in a broad band of the medium wavelength infrared region and high sensitivity at room temperature. As photonics devices, they are useful for a wide range of applications where a fast response is mandatory. These include applications such as detection and identification of chemical warfare agents or the detection of targets and threats in a cluttered environment.

We report on the manufacture of a monolithic dual band uncooled infrared detector of lead selenide for smart detection. We provide selectivity to our sensors by means of multispectral discrimination, in order to produce advanced devices for detection at different wavelengths. Narrow bandpass interference filters are designed and produced. Filters are double Fabry-Perot cavities with demanding requirements that involve high transmittance for the pass band, and a broad rejection range with very low transmittance.

Vapor Phase Deposition (VPD) technique allows the monolithic integration of lead selenide directly on the thin films stack of the interference filter, resulting in a sensor with spectral discrimination tailored by design [1,2]. A multicolour device was developed by hybridization of individual sensors with their spectral discrimination monolithically integrated [3]. The combination of photolithography process with the deposition method of filters enables to achieve two different filters on a single substrate, so monolithic integration of PbSe detectors with two high pass filters resulted on the first bicolor device monolithically integrated [4]. Recently, another enhancement to the final product has been achieved by means of the dual monolithic integration of PbSe sensors on narrow band pass interference filters. The demanding requirements of some applications involve the use of filters with a high number of layers that are affected by the processing of lead selenide sensor. Mechanical instability led us to use hybrid instead of monolithic configurations [3]. Now we have successfully solved this fact and we are able to produce dual band monolithic devices.

Figures

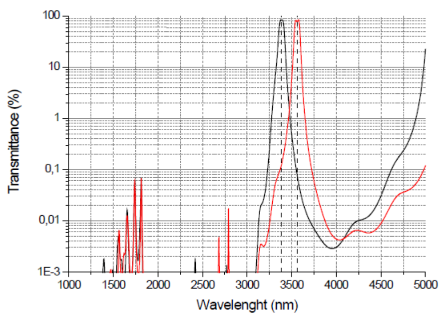

Figure 1: Transmittance spectra of the two band pass filters designed. They have maximum transmittance above 80%, bandwidth around 2% of the center wavelength, transmittance out of the pass band below 0.1%.

Figure 2: Photograph showing a PbSe detector deposited onto a configuration of two pass band interference filters. Each detector is formed by four sensors: two of them (purple) have only the common low wavelength rejection and the other two have the band pass filters of figure 1 (red and orange).

References

[1] ..J. Diezhandino, G. Vergara, G. Pérez, I. Génova, M. T. Rodrigo, F.J. Sánchez, M.C. Torquemada, V. Villamayor, J. Plaza, I. Catalán, R. Almazán, M. Verdú, P. Rodriguez, L.J. Gómez, M.T. Montojo. “Monolithic integration of spectrally selective uncooled lead selenide detectors for low cost applications”. Applied Physics Letters. 83 (2003) 2751.

[2].. M. C. Torquemada, M.T. Rodrigo, L.J. Gómez; V. Villamayor, D. Fernández, R.M. Almazán, J. Plaza, C. Sierra, I. Génova, I. Catalán, C. Gutiérrez, M. Álvarez, M.T. Magaz . “Desarrollo de Sensores sin Refrigerar de PbSe Dotados de Discriminación Espectral”. Congreso Nacional de I+D en Defensa y Seguridad. 5-7 Noviembre, 2013. Madrid.

[3] ..C. Sierra, M.C. Torquemada, G. Vergara, M.T. Rodrigo, C. Gutiérrez, G. Pérez, I. Génova, I. Catalán, L.J. Gómez, V. Villamayor, M. Álvarez, D. Fernández, M.T. Magaz, R.M. Almazán. “Multicolour PbSe Sensors for analytical applications” Sensors and Actuators B 190 (2014) 464-471.

[4] ..M. C. Torquemada, V. Villamayor, L.J. Gómez, G. Vergara, M.T. Rodrigo, G. Pérez, I. Génova, I. Catalán, D. Fernández, R.M. Almazán, M. Álvarez, C. Sierra, C.M. Gutiérrez, M.T. Magaz, J. Plaza. “Monolithic integration of uncooled PbSe bicolor detectors”. Sensors and Actuators A 199 (2013) 297-303
.