KEY PARAMETERS FOR INFRARED DETECTORS RANGE IMPROVEMENT IN THE SWAPC AND PITCH REDUCTION CONTEXT

02. Sensors and Components

J. Berthoz [1], L. Rubaldo [1], A. Brunner [1], G. Vojetta [1], M. Maillard [1], N. Jomard [1], S. Courtas [1], F. Rochette [2].
[1]Lynred - Veurey-Voroize (France), [2]CEA - Veurey-Voroize (France)

Introduction

Joining their technological skills and strengths, SOFRADIR and ULIS have merged in a new High Tech Company named LYNRED. This new company will be oriented towards excellence in II-VI, III-V and bolometers technologies, covering all Society's needs in term of infrared detection.

One noticeable trend in infrared market detectors is to optimize two key performances: detector range and image quality. These performances depend mostly on three criteria: modulation transfer function (MTF), Noise Equivalent Temperature Difference (NETD) and Residual Fixed Pattern Noise (RFPN). MTF improvement was previously achieved by reducing the pixel pitch to 30.0µm[1] to 10.0µm[2]. NETD and RFPN were improving thanks to a better material quality. The improvement of NETD and RFPN can also be used for increasing the operating temperature.

One question today is to know if, with smaller pixel pitch, a larger range and a better image quality are still achievable. We will discuss about the trade-off between the criteria with different materials, structures design, optical and electrical transport properties.

Discussion

Modulation Transfer Function performance is directly linked to the ability to distinguish objects details and to the sharpness of the imaging system. MTF value determines, with NETD and RFPN, the system range via the so-called Minimum Resolvable Temperature Range (MRTD). We need to keep in mind that not only MTF has to be optimized but also MRTD, which is very challenging in a context of High Operating Temperature and pixel pitch reduction.

In this context we will compare several existing technologies, elementary detectors structures and materials, such as III-V super-lattice, II-VI materials, MESA, hetero-barrier, loophole, planar and depleted structures. This discussion will be based on measurements on improved HgCdTe 10µm and 7.5µm pitch technology completed by simulation using Finite Element Modelisation (FEM) coupled with Finite Difference Time Domain (FDTD).

Conclusion

There are many challenges to be addressed for future small pitch, large format and HOT+ (> 160K) detectors. Electrical and optical crosstalks are one of the prime concern for detectors with pixel pitch below 7.5 µm and some possible trade-offs showing have been discussed showing that the mandotory NETD/FTM ration must be optimized.