Raman imaging for spatially resolved thermal characterization of materials and operating devices

Valentina Mussi

VisLab, Vibrational Spectroscopy Lab

IMM-CNR Roma Tor Vergata

Raman scattering is one of the inelastic processes associated with light-matter interaction: when a sample is irradiated with monochromatic light, the incident photons undergo inelastic scattering caused by the lattice vibrations characteristic of the material, so that the frequency of the emerging radiation is shifted with respect to the initial one of an amount corresponding to that characteristic of the vibration itself. The measurement of the scattered light spectrum therefore allows to obtain fundamental physico-chemical information on the investigated sample [1].

Micro-Raman imaging, i.e. the mapping of the Raman signal by micro-probe, has thus become a standard technique applied to obtain a quick overview of the spatial variation of different physical quantities in semiconductors: the distribution of the strain, the concentration of the carriers, the presence of crystalline defects, and so on. In particular, by exploiting the temperature dependence of the frequency of the characteristic phonons of a material, it is possible to use Raman spectroscopy also for the thermal characterization of devices, also in operating conditions due to the label-free, non-contact and non-invasive character of the technique.

Raman thermography method will be described, and some results concerning thermal studies of operating HEMT devices will be presented for different dissipated powers, and compared with the predictions of electro-thermal simulation models [2].

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References:

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[2] A. Valletta et al., “Hybrid electrothermal simulations of GaN HEMT devices with a reliable estimation of the compact model parameters”, under preparation.