Combining Atom Probe Tomography with High-Resolution Scanning Transmission Electron Microscopy and Micro-Photoluminescence Spectroscopy for the study of semiconductor heterostructures

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In the last few years, laser-assisted atom probe tomography (La-APT) has emerged as a powerful tool for the analysis of semiconductor heterostructures in 3D and at the nanoscale. The application of APT with transmission electron microscopy and optical spectroscopy techniques to the study of nanoscale objects may yield an extremely deep insight into the relationship between structural and optical properties when the obtained data are combined to yield a consistent and rich set of information. The methods of application may have increasing degrees of accuracy – and technical difficulty – which can be classified as (i) comparative approaches, in which different nanoscale parts of the same macroscopic sample are studied by the three techniques and (ii) correlative approaches, in which the same nanoscale object is subsequently studied with the three techniques. These approaches can be implemented in the study of heterostructure interface definition, presence of defects, carrier localization and optical emission in quantum confined systems, such as the AlGaInN and AlGaAs quantum well (QW) and quantum dot (QD) systems presented here. [1,2]. Furthermore, the use of complementary techniques may be extremely helpful for a correct interpretation of atom probe results, which are not always exempt of artefacts and biases [3,4].

[1] L. Rigutti et al., Nano letters (2014), **14**, 107–114. [2] L. Mancini et al. Appl. Phys. Lett. (2014) **105**, 243106. [3] L. Mancini et al. J. Phys. Chem. C (2014) **118**, 24136-24151. [4] L. Rigutti et al., Ultramicroscopy (2013), **132**, 75-80.