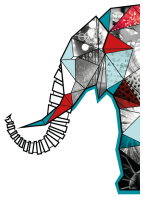
25e Congrès Général de la Société Française de Physique



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Three-dimensional atomic scale multi-microscopy study of structural and optical properties of ZnO/ZnMgO quantum wells

vendredi 12 juillet 2019 09:15 (15 minutes)

Non-polar or semi-polar ZnO/(Zn,Mg)O multi-quantum wells (MQW) on ZnO substrates are key materials for quantum cascade devices relying on intersubband transitions at long infrared wavelengths, potentially operational at room temperature because of the relatively high LO-phonon energy. This system has been investigated herein by adopting an advanced correlative microscopy approach. Laser-assisted Atom Probe Tomography (La-APT), 3D Scanning Transmission Electron Microscopy (STEM) and micro-PhotoLuminescence (μ-PL) were performed on atom probe tip specimens. Complementary La-APT and STEM structural investigations yield a clear picture of both morphology and composition of such system. The ZnO/(Zn,Mg)O MQWs are planar with variable widths gradually decreasing from 5.4 to 1.2 nm. The Z-contrast electron tomography corroborated with the quantitative STEM-EDS and La-APT essays identifies the smooth topography of the ZnO QWs surface. Both μ-PL and systematic La- APT investigations allow to successfully determine the composition of (Zn,Mg)O barriers and to elucidate the carrier localization mechanisms within the QW. Effective mass calculations of interband and intersubband transition energies based on 3D structural data are in excellent agreement with the experimental μ-PL spectra and the photo-induced absorption spectroscopy under UV irradiation on thin film. This approach can be extended to other low-dimensional systems to explore the properties of single quantum light emitters.

Choix de session parallèle

6.2 Techniques couplées et analyses multispectrales dans le domaine des matériaux

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Classification de Session: Séance Parallèle