Advanced TEM techniques for the study of wide-bandgap semiconductors, terrestrial and/or extraterrestrial natural materials

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Nowadays, transmission electron microscopy (TEM) has become an essential technique for materials characterization allowing to visualize their microstructure at different scales from micrometer (µm) down to atomic scale. The Centre de Recherche sur l'Hétéropitaxie et ses Applications (CRHEA) is a laboratory dedicated to the study of epitaxial materials such as wide-bandgap semiconductors (element III nitrides, ZnO-based oxides, etc) and recently 2D materials (graphene, TMDs-transition metal dichalcogenides) with application in optoelectronics and photonics. As part of the ACT-M (Advanced Characterization Method for Materials) infrastructure, CRHEA has been recently equipped with a state-of-the-art transmission electron microscope (TEM), a G4 ThermoFisher SPECTRA200, equipped with a cold field emission gun (FEG), a Cs probe corrector, a dual EDX(energy dispersive X-Ray) detectors with high energy sensitivity (solid angle: 1.8sr) and a Nanomegas ASTAR orientation/phase mapping module based on collection of precession electron diffraction pattern. Besides advanced techniques, such as integrated differential phase contrast (iDPC) or four-dimension Scanning transmission electron microcopy (4D-STEM), can be employed to visualize the position of each atomical column within the materials crystalline structure. The high spatial resolution of the equipment, 0.7 Å at 200kV, enables chemical and structural characterization of this type of materials down to the atomic scale, which is essential for understanding and controlling their properties. The electron microscope is perfectly suited for the study of other materials such as terrestrial or extraterrestrial natural materials through the archeomaterials or life science materials.

Within this presentation through different studies the potential of advanced techniques available on the equipment will be presented.