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Precession enhanced Electron Diffraction Applications in TEM

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Abstract

Precession electron diffraction (PED) technique in transmission electron microscope (TEM) offers advanced high resolution analysis in nanomaterial science. Among several applications, ASTAR technique provides **Orientation and Phase maps at 1-3 nm resolution** (in case of FEG-TEM) for a variety of materials (metals, semiconductors, oxides etc.). The technique - that is similar to EBSD-SEM technique - is based on collection of several PED patterns on a crystalline area that are indexed after matching with theoretically generated templates of known structures.

PED has been recently successfully applied to obtain **Strain mapping** analysis of semiconductor materials **at 1-4 nm resolution** (in case of FEG-TEM, **sensitivity 0.02%)**, based on comparison of NBD patterns from strained / reference un-strained areas. Both automatic techniques are straight forward, can be applied to any TEM and may provide extremely fast, accurate and reproducible results. Other applications of PED in TEM, is automatic PED based **3D diffraction tomography** (ADT3D or Micro ED) for structure determination of nanocrystals, and a**morphous material analysis using Pair Distribution Function** (e-PDF) approach.

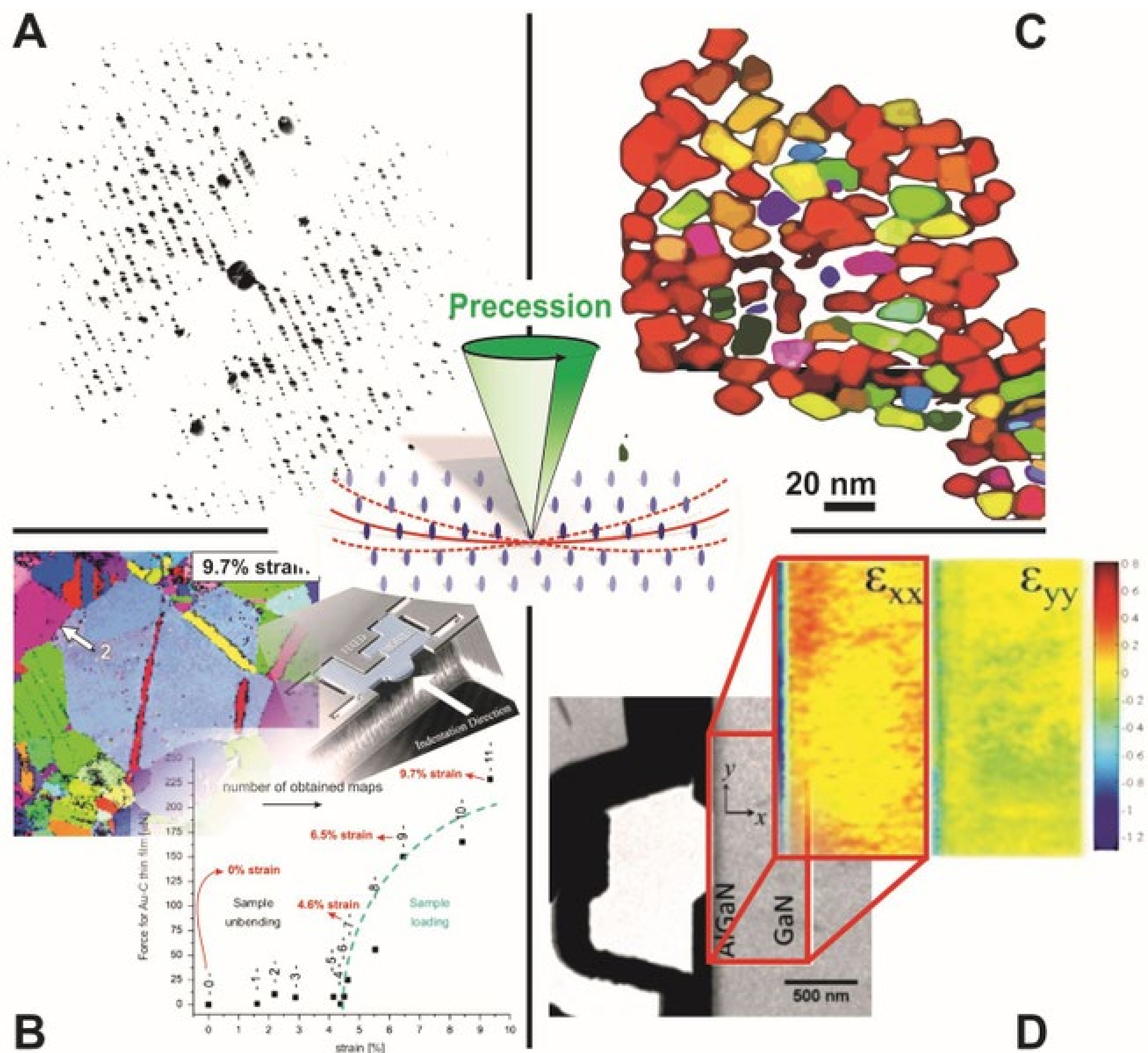

Figure 1. 3D reconstructed reciprocal space obtained by PED tomography (A). Plastic deformation *in situ* analysis combining specific specimen holder device and orientation mapping in different steps (B). Orientation Map of Au-nanoparticles obtained by ASTAR technique in TEM (C). Strain mapping analysis of AlGaN / GaN system used as High Electron Mobility Transistor (HEMT) (D)

Keywords

Precession Electron Diffraction (PED); Orientation and Phase mapping; ASTAR; Strain mapping; TopSPIN; 3D diffraction tomography; Electron Crystallography; amorphous materials; Pair Distribution Function.