ESRF	**Experiment title:** Coherent diffraction imaging using focussed X-ray beam of single crystalline InP nanocrystals selectively grown on nanotip-patterned Si wafers	**Experiment number**: MA-3063
Beamline: ID01	**Date of experiment**: from: September 1st, 2016 to: September 6th 2016	**Date of report**:
Shifts: 15	**Local contact(s)**: Steven Leake	*Received at ESRF:*

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Report:

The samples consist in highly single crystalline InP nanocrystals, which were selectively grown on nanotip-patterned Si wafers. Due to the highly heterogeneous feature of InP/Si system, defects like dislocations, stacking faults (SFs), microtwins (μ-Tws) and anti-phase domains (APDs) can exist in epitaxial InP materials (see Fig. 1). The innovative Si nanotip approach providing nm-size Si crystalline seeds is expected to effectively decrease the crystalline defect density in InP crystals.

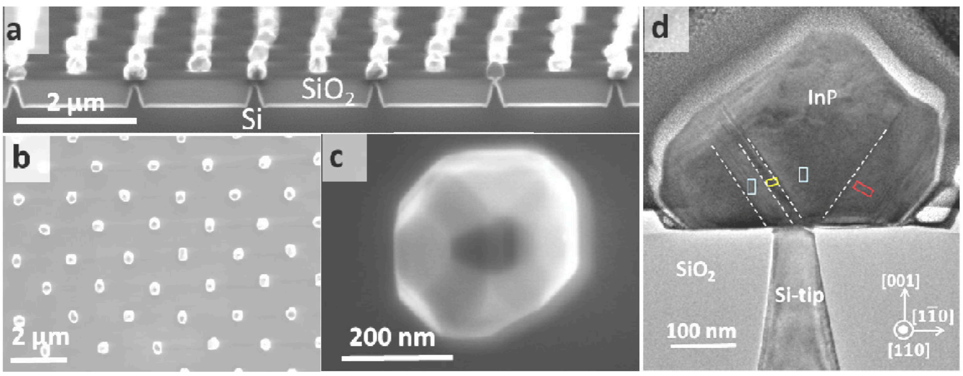

Fig. 1: SEM images of InP nanocrystals on the Si nanotip wafer (a) cross-sectional view; (b) plane-view; (c) plane view on a single island. (d) Cross-sectional TEM image of InP/Si-tip. The rectangles indicate the orientations of SFs and μ-Tws.

We succeeded to perform Bragg coherent diffraction imaging (Bragg-CDI) on single crystalline InP nanocrystals. The coherent X-ray beam, monochromatized to an energy of 8 keV, was focused down to a beam size of 100 nm (V) x 300 nm (H) using a Fresnel zone-plate at the ID01 beamline. We have recorded full three-dimensional (3D) rocking-curves in the vicinity of the the **002** InP Bragg reflection (Bragg angle of 15.2°). Figure 2 displays the 3D diffraction pattern of one selected InP nanocrystal. Interestingly, three well defined streaks are observed. Two of them are along <111> directions. Along these streaks, the thickness fringes lead to a distance of about 30 nm in real space, which is much smaller than the size of the particle (see Fig. 1c). These streaks may arise from {111} stacking faults or μ-Tws, as displayed in Fig. 1d. The third one is an asymmetrical bent streak. This asymmetry is also a clear sign of a strong phase structure (hence, defect structure).

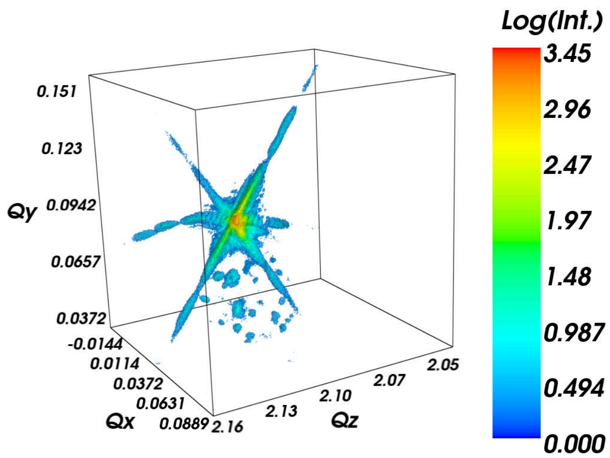

Fig. 2: 3D diffraction pattern of a selected InP nanocrystal displayed as a function of the reciprocal space coordinates (Q_x, Q_y and Qz) in Angströms and measured at the **002** InP Bragg reflection.

Figure 3 displays the diffraction patterns of two crystalline InP nanocrystals as a function of Q_x, Q_y and Q_z reciprocal space coordinates. The diffraction patterns of these two nanoparticles show similarities: streaks along the same directions are observed in Figs. 3 (c-f) but with different sizes of thickness fringes, implying different sizes of {111}-type defects.

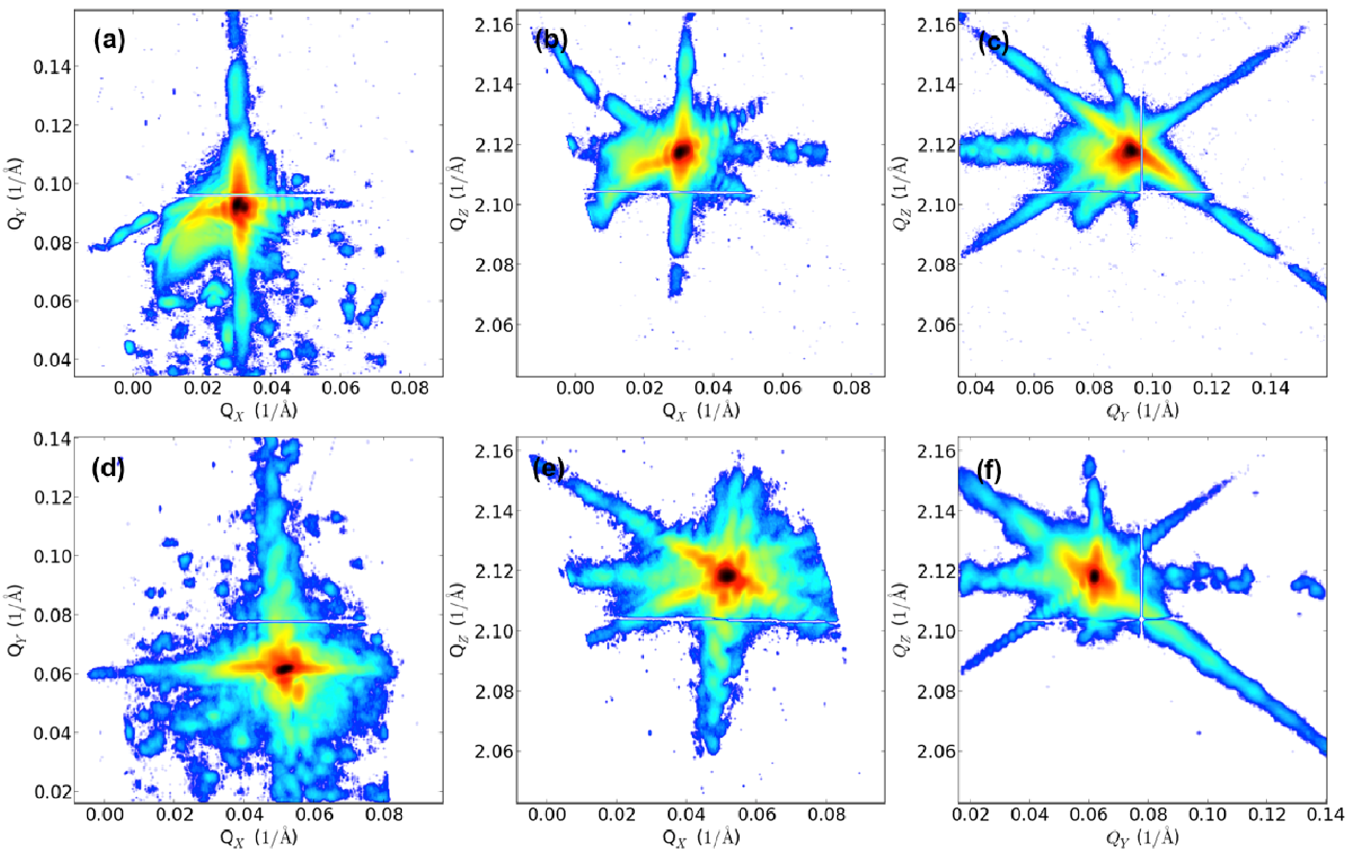

Fig. 3: Summed diffraction patterns displayed in the (Q_x,Q_y) (a, d), (Q_x,Q_z) (b,e) and (Q_y, Q_z) (c,f) of two InP nanocrystals, respectively.

Diffraction patterns of the sample are used to reconstruct the electron density and phase of the nanoislands to reveal stacking-faults and twins by iterative schemes. Work is in progress.