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ESRF	**Experiment title:** GISAXS study of the morphology of CoPt and $CoPt_3$ epitaxial nanostructures grown on the low energy surfaces WSe_2(0001) and NaCl(001)	**Experiment number**: 02-01-734
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Report:

The CoPt and $CoPt_3$ nanostructures were prepared by co-deposition of Co and Pt atoms under UHV on the (0001) van der Waals-type surface of WSe_2 and the (001) low energy surface of NaCl. As observed by in-situ RHEED observations, the CoPt and $CoPt_3$ nanostructures grow in epitaxial relationships with the WSe_2(0001) surface up to deposition temperatures of 870K and on NaCl(001) essentially around 530K.

The size and morphology of the self-assembled nanostructures were studied by grazing incidence small angle x-ray scattering (GISAXS) measurements on the small angle scattering stage of the BM02 beamline. These measurements were combined with other characterization techniques (TEM, STM and Field Emission-SEM). The samples in a portable UHV valise could be transferred without air exposure in the new GISAXS chamber designed for 10^{-6} torr. Deposits of alloys with various nominal thicknesses (t) and prepared at different temperatures (T_g) were measured under incidence angles closed to the critical values of the substrates. Preliminary radial analyses of the GISAXS patterns performed in vertical and horizontal regions lead to rough estimates of the particle sizes within the Guinier approximation. Simulations of the full patterns were then performed using the IsGISAXS program of R. Lazzari to determine the shapes.

On WSe_2, the decrease of the aspect ratio r=h/l (h and l being the height and the lateral size) with increasing the growth temperature observed by STM was confirmed by GISAXS in small deposits (t<0.1nm). Above 700K, the change from a hexagonal shape formed by alternate {001} and {111} side-wall facets to a triangular shape formed by extended {111} large facets and small {001} facets, which was clearly observed by STM in deposits of 3nm,

was not retrieved by GISAXS. Indeed, faceting is observed by GISAXS, however with a larger sensitivity to the less inclined {001} side-wall facets, which are expected in minority (see Fig.1). For highly dense assemblies as obtained for t=1nm, information extracted from GISAXS analysis would be restricted to the upper part of the particles due to a coarsening morphology of their lower part.

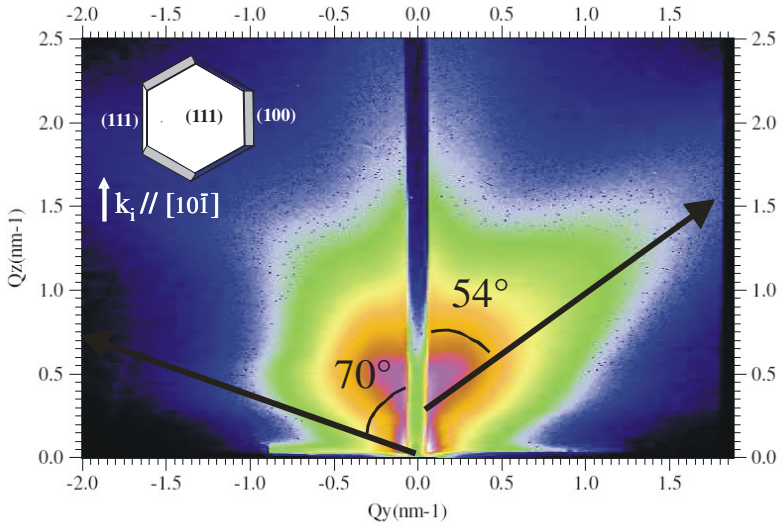

Figure 1: GISAXS pattern of 111-oriented $CoPt_3$ nanostructures grown at 700K on WSe_2 (0001) surface with the incident beam parallel to [10-1]$CoPt_3$.

The nanostructures grown on NaCl (001) have a truncated pyramid shape with an aspect ratio of 0.75 for T_g=530K, i.e significantly larger than the value of 0.4 found for nanostructures grown at 530K on WSe_2. The {111} side-wall facets of nanostructures with l~10nm are well observed by GISAXS (Fig.2), while for smaller nanostructures (l<5nm) such faceting effect is absent and simulated patterns cannot differentiate a cubooctahedral shape from a spherical shape.

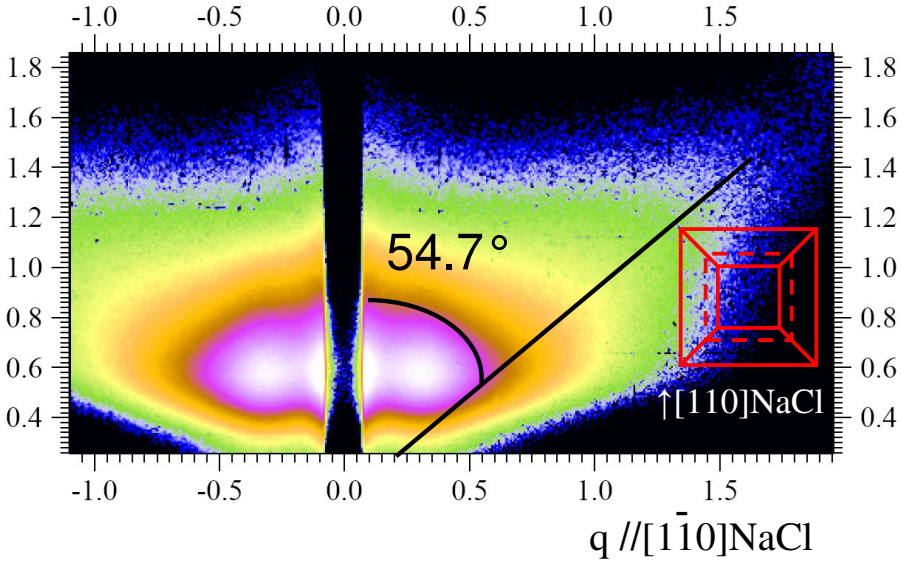

Figure 2 : GISAXS pattern of 001-oriented $CoPt_3$ nanostructures grown at 570K on NaCl(001), with the incident beam parallel to [110]NaCl.