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Report: We have investigated two types of lateral nanostructures with correlation lengths of up to 500nm by depth sensitive x-ray scattering under grazing incidence conditions. Both experiments were performed using an analyzer crystal for high in-plane resolution. **Periodic near-surface grating on GaAs/AlGaAs: 75nm** of MBE grown $Al_{0.35}Ga_{0.65}As$ on GaAs (100) substrate was capped by 10nm of GaAs and exposed to a nsec pulse of a periodic laser hologram of 190nm periodicity. In order to separate the laser induced changes at the buried interface from those not deliberately produced at the sample surface, a sample of pure GaAs, treated in the same way, was used for comparison. The small angle satellites resulting from the lateral grating were measured for the first time out of the plane of incidence (GISAXS), by placing the grating parallel to the incoming x-ray beam. In order to resolve the grating satellites we introduced a Si analyzer crystal after the sample. We were then able to follow the complete q_z dependence of up to 12 satellite orders by mapping the reciprocal space in q_x-q_z plane. The crystalline properties of the structured sample were investigated in a similar way by grazing incidence diffraction close to the (220) surface reflection. The results are shown in Fig. 2 for the forward direction and in Fig. 3 for GID. Here the main reflection contains oscillations along q_z resulting from the 75nm AlGaAs layer. On the satellite these oscillations are no longer visible; we thus conclude, that the grating structure did not penetrate to this depth. In fact the oscillations on the q_z direction of the satellite correspond to a thickness of 6nm which is due to a polycrystalline layer which has diffraction contrast but no electron density contrast. Detailed model simulations are underway and will soon be published. **Self assembled Ge/Si-dot multilayers** (lattice mismatch 4 %) have been investigated by triple crystal grazing incidence diffraction (TCGID). The dots have been grown at 670° C substrate temperature on a (001)-oriented Si-wafer. The nominal coverage was 5.5 monolayers at a Ge-growth rate of 0.075 Å/s. 19 dot layers were grown with 400 Å thick Si-spacers in between.

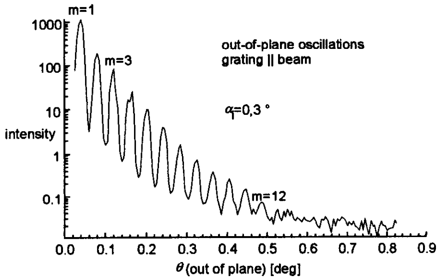

Fig.1: grating induced satellite reflections

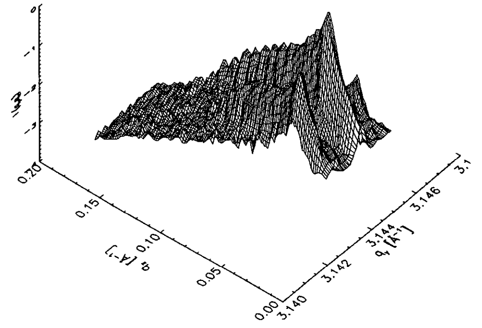

Fig.2: Intensity distribution close to (220) surface reflection

The application of TCGID to this quantum dot system allowed for a depth dependent characterization of vertical and lateral correlations in the sample. The high degree of vertical ordering of the dots in the various layers was derived by comparing scattering intensities at and in between the Bragg-positions of the multilayer along the CTRs of the dots. As for the lateral ordering of the dots within a Ge-layer, measurements from different reflections revealed a local quadratic ordering with a lattice parameter of 5230 ± 200 Å (Fig. 3). Most interesting results were obtained from iso-strain scattering, a method that is currently being developed to reveal details on the strain distribution inside 3D-islands grown in the coherent Stranski-Krastanow regime. The dots at the free surface exhibit a broad distribution of relaxation, ranging from the coherent condition at the Ge-wetting layer to fully relaxed at the tip of the dots. Dots in the buried Ge-layers are compressed by the surrounding Si-spacer with their maximum relaxation at 15 % of completely relaxed Ge. In iso-strain scattering experiments, areas of equal relaxation are found for different heights above the wetting layer. For the near-tip regions of the dots on the free surface, the iso-strain areas were found to be of pyramidal shape with an average inclination of 11° (Fig. 4) indicating a {105}-facetting of the islands. When approaching the wetting layer, the iso-strain areas tend towards a flat shape with steeper flanks. Further measurements of selected regions in reciprocal space will be designed to help us in modeling the α_f-dependence of the recorded mappings, thereby achieving a complete space-resolved strain mapping of the coherent island. Information on the spatial configuration of the dots will be vital for the interpretation of electronic properties and for the understanding of the coherent Stranski-Krastanow growth process.

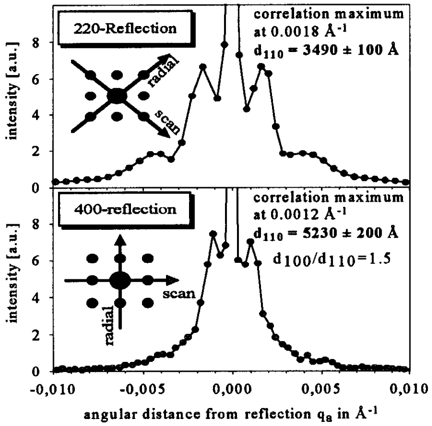

Fig. 3: Lateral correlations of surface dots in different lattice directions

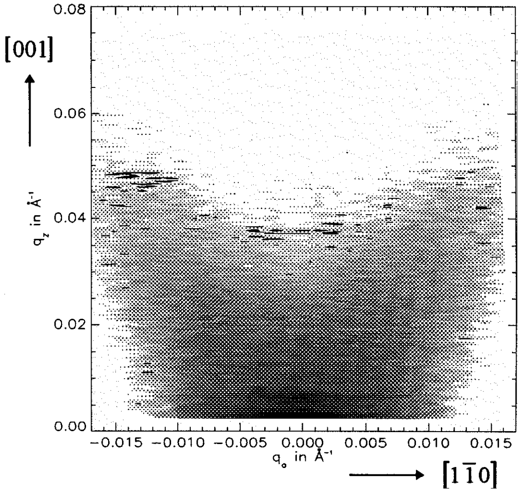

Fig. 4: Intensity distribution at the (220) surface reflection due to pyramidal iso-strain areas.