ESRF	**Experiment title:** X-ray Absorption Spectroscopy from single Quantum Dots of Ge by detection of photoemission current via a conductive AFM tip	**Experiment number**:
Beamline:	**Date of experiment**: from: 17/11/2003 to:22/11/2003	**Date of report**: 1/3/2004
Shifts: 12	**Local contact(s)**: Remi Touculou	*Received at ESRF:*

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Report:

The goal of the experiment as it results from the submitted proposal was the following:

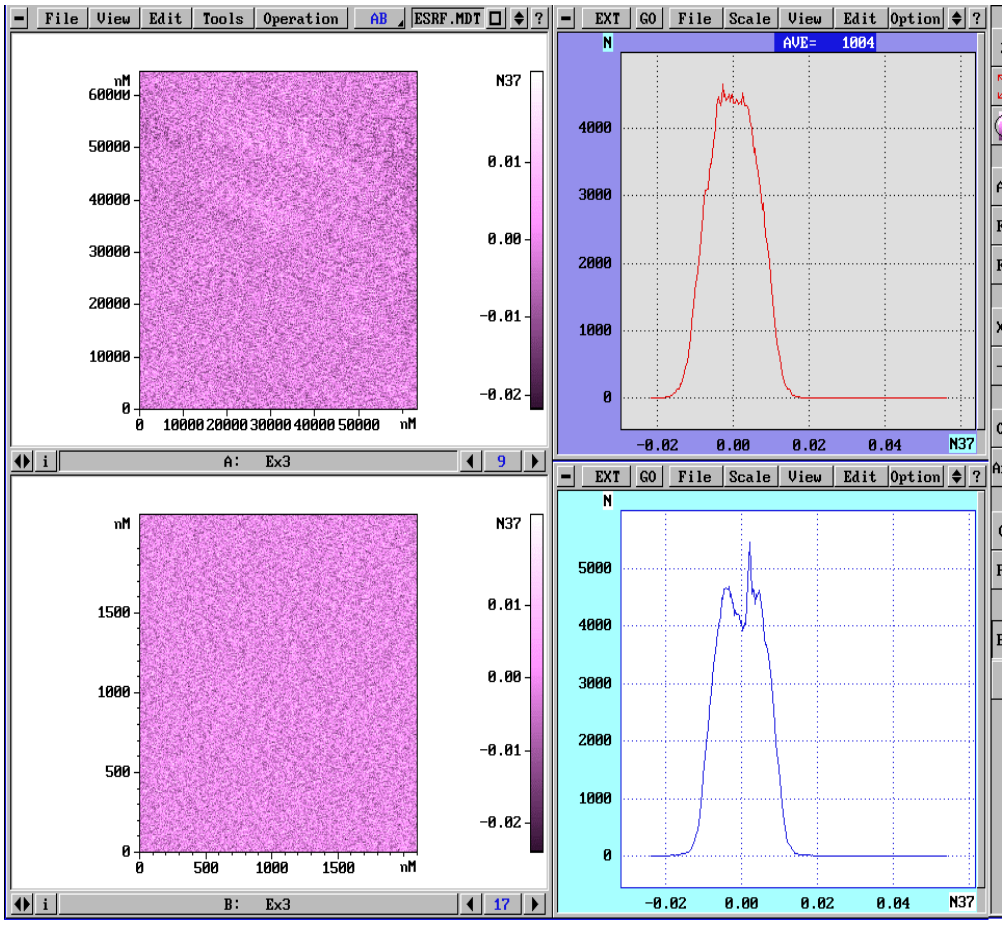
- Implementation of an AFM instrument under moderate vacuum with a geometry convenient for the illumination with X-ray microbeams delivered by the ID22 KB system.
- Implementation of a vacuum system compatible with the optical bench of ID22 and provided with input and exit windows for alignment.
- Preparation of suitable shielded tips provided with guard electrodes for better localisation of the collected charge[2].

The final aim was un assessment of the feasibility and of the difficulties inherent to the association of X-ray microbeam and local probe microscopies.
To this goal a special vacuum vessel has been designed and manufactured taking in account the constraints of the short working distance between the KB optical system and the sample, the short distance between the nose of the fluorescence detector used to align the tip on the beam, and finally the need of having enough slack on the alignment of the entire system.

No problem has been found on the general conception of the vacuum vessel and on its mechanical way of alignment.
It has been instead quite difficult to consistently converge sample, tip and focal spot (2x1 micron) on the same point with remote positioning and using only one high

resolution optical microscope. It has been then necessary to temporarily install a second optical microscope.
From this experience we learnt that a consistent alignment can only be achieved by using TWO microscopes: one linked to the vacuum vessel and meant to align tip and sample on the same spot, and a second microscope fixed on the X-ray focal spot. Only in this condition it will be easy to align the two focii on the same point.
A second point to verify was to ascertain the response of a tuning fork head equipped with a fiber optic. Question was to check if a first signal was visible and the level of noise. The experiment has been done on a quantum dot sample Er doped that luminesce on the visible.
The figures below shows the intensity distribution on a uniform sample and on a QD sample. This last sample shows consistently a peak on the right side of the distribution that we attribute to signal from the QDs under X-ray excitation. The tip was a low resolution tip, then smearing out considerably the signal.
The results of this first attempt shows in which directions we should proceed:

- **perform accurate simulations to determine the electron yield expected**
- **improve the current detection system (adapt it to very low currents)**
- **install an optical microscope on the vacuum vessel for tip alignment**
- **procure and install a high resolution tip for SNOM measurements**
- **provide the microscope head with a remote controlled coarse approach system: the manual one installed was not reliable enough leading often to tip crash.**



Uniform sample

QD nanostructured sample

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