

ALLIANCE 9: FACILITIES

Research axes and facilities

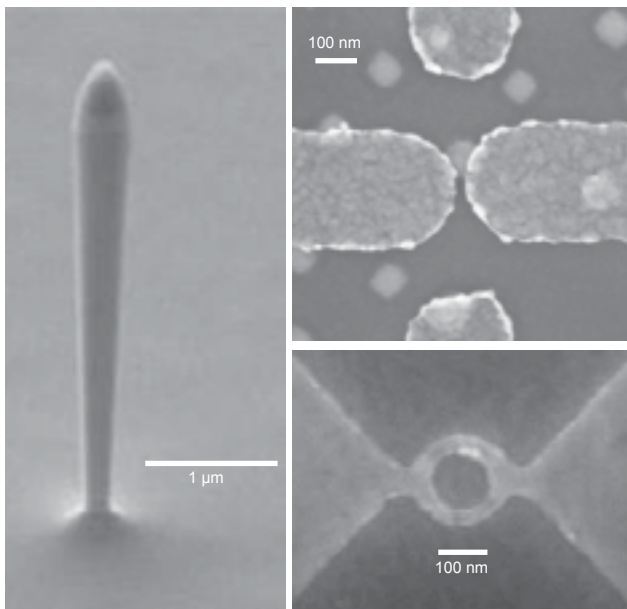
Research in nanosciences generally requires the ability to fabricate nanostructures in a controlled way and to characterize their structural properties (shape, size, composition) with a high resolution. LANEF partners have developed over the last thirty years a strong expertise in the “bottom-up” fabrication of semiconductor, metallic and magnetic nanostructures, starting from their atomic constituents. Another key resource for nanosciences is “top-down” nanofabrication, which uses processing tools initially developed for microelectronics (lithography, etching). LANEF partners have built open access clean-rooms such as Nanofab and they are strongly involved in the development and exploitation of Grenoble’s upstream nanofabrication center (PTA), one of the six main nanofabrication facilities in France. Over the last twenty years, LANEF researchers have also made key contributions to the development of nanocharacterization tools and methods, mainly based on synchrotron radiation and on electron microscopy. Nowadays, they are in charge of three beamlines at the European synchrotron (ESRF), and are strongly involved in the world-class nanocharacterization facility PFNC.

Actions involving LANEF

Grenoble physicists have always been particularly active in developing specific instruments, and the experimental set-ups available in the labs are one of our strengths. Here we give three examples of shared facilities.

The Upstream Nanofabrication Center (PTA).

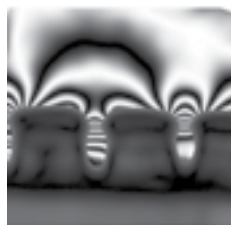
Research programs in nanophotonics, spintronics and nanoelectronics depend to a large extent on access to a first class and flexible clean room facility. This led the academic community in Grenoble to join forces to create the PTA in 2007. Nowadays, the PTA is fully operational and gathers within a 700 m² clean room first class equipment, that is fully dedicated to upstream research. With around 200 users, the PTA is open to senior scientists, post-docs and PhD students, who learn and share precious expertise in nanofabrication.



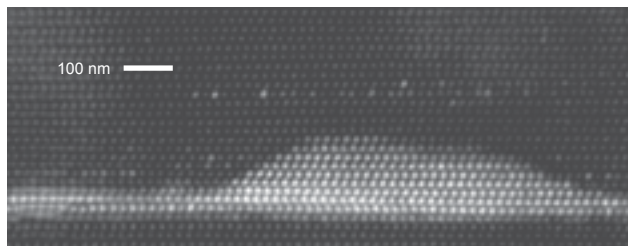
*Some nanostructures made @ PTA:
photonic wire (left),
single electron quantum dot transistor (top),
ferromagnetic ring for transport studies (bottom).*

The Nano-Characterization Facility (PFNC). Created in 2006 at CEA-Grenoble, PFNC gathers research teams involved in basic research as well as in R&D around world-class scientific instruments.

Available characterization techniques of particular relevance for LANEF’s research axes are electron microscopy, X-ray diffraction, surface analysis techniques, nuclear magnetic resonance, near-field microscopy and spectroscopy. These techniques provide, either alone or combined, a detailed knowledge of the structural and physical properties of nanostructures on the nanometer or atomic scales.



Imaging of the magnetic field around magnetic pixels by electron holography



High-resolution electron micrograph of a GaN quantum dot and of isolated Tm dopant atoms

Collaborating Research Groups (CRGs) @ ILL & @ESRF.

Since the construction of the ESRF in the early 90’s, LANEF partners have together been in charge of the development and operation of three synchrotron beamlines: the “French” CRGs IF, D2AM and FAME. Simultaneously, they have been responsible or co-responsible for 5 neutron instruments (IN12, IN22, D1B, D15, D23) at the ILL. These CRGs are mainly dedicated to the study of surfaces, interfaces and nanostructures, new materials (for microelectronics, energy,...), nanoparticles and ecotoxicology (catalysis, pollution of soils, bioremediation...). In recent years, LANEF researchers have for instance developed a novel set-up dedicated to the in situ study of nanostructures during their growth, and a X-ray microdiffraction set-up which is unique in Europe, and enables probing the strain and orientation of each individual submicron grain within a polycrystalline material. Besides research projects carried on by LANEF teams, this resource is open to the French and European communities, through public project calls and selection by external scientific committees. More than one hundred projects, and as many publications, are realized on these 8 CRGs per year.