



ELECTRON MICROSCOPY DIVISION

Led by Dr. Belén Ballesteros, the Electron Microscopy Division focuses on the use of electron microscopy techniques for nanoscience and nanotechnology research and applications. The main aim of the division is to provide scientific-technical support to the ICN research lines and to neighboring research centres, as well as developing and implementing novel related techniques. The laboratory has been selected by FEI as a Centre of Reference for development of joint experiments and workshops related with electron microscopy.

BACKGROUND

Recent advances in nanoscience and nanotechnology, with an ever decreasing size of materials and structures, brings the need for advanced characterisation with high spatial resolution to obtain a deep understanding of the structure-property-function relationships. In this context, electron microscopy has become a key characterisation tool since it provides structural, chemical and morphological information of a wide range of nanomaterials and nanostructures. Recent developments in both scanning and transmission electron microscopes have dramatically improved their image and nanoanalysis capabilities, making feasible for instance the day-to-day study of crystallographic periodicity of structures at the atomic level and the study of high-vacuum incompatible specimens by SEM working in environmental mode, among others.

RESEARCH ACTIVITIES INCLUDE:

High resolution imaging (SEM, TEM, Z-contrast STEM)

High resolution imaging is obtained in all our microscopes with a wide variety of detection systems. The *Magellan 400L* extreme resolution (XHR) SEM offers subnanometer resolution over the full 1 kV to 30 kV electron energy range, providing surface specific information otherwise unattainable, and the *Quanta 650 FEG* environmental SEM (ESEM) is especially suited to study specimens at low vacuum and extended vacuum (environmental) conditions. The *Tecnai G² F20* provides atomic resolution both in HRTEM and in HAADF STEM (Z-contrast).

Chemical analysis at the nanoscale (EDS, EELS, EFTEM)

Point analyses, line profiles and chemical maps are readily available in the *Quanta 650 FEG* and the *Tecnai G² F20*. The *Quanta 650 FEG* is coupled to an Inca 250 SSD XMax20 detector for EDS analysis. On the other hand, the *Tecnai G² F20* is a powerful analytical tool thanks to its EDAX detector for EDS studies and the new generation GIF QuantumSE imaging filter for high performance EELS and energy filtered imaging. Spectrum imaging and profiling capabilities are available in STEM mode for both EDS and EELS.

Structural characterisation by electron diffraction

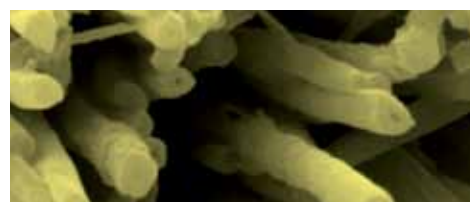
Study of crystalline specimens by electron diffraction is possible in the *Tecnai G² F20*. The electron diffraction pattern formed at the back focal plane of the microscope can be projected to the viewing device, providing information about the crystal lattice.

Dynamic in-situ experiments

In-situ microscopy for observing dynamic processes at the nanoscale is carried out in the *Quanta 650 FEG ESEM*, with control over temperature and humidity provided by a heating stage which can get up to 1000 °C and a Peltier cell which allows reaching humidity up to 100%.

Electron tomography

3D information of nanomaterials is obtained by TEM and HAADF STEM electron tomography in the *Tecnai G² F20*, using a high-tilt tomography holder and the specific software for data acquisition, reconstruction and visualisation.



DR. BELEN BALLESTEROS
DIVISION LEADER

Dr. Belén Ballesteros graduated in Chemistry with Honours at the Universitat Autònoma de Barcelona in 2001 and obtained her PhD in 2006 at the Institut de Ciència de Materials de Barcelona (ICMAB-CSIC). During her predoctoral studies she carried out research stays at different European universities, including University of Twente (Netherlands), University of Oslo (Norway), University of Saint Andrews (UK) and Universidad de la Laguna (Spain). In July 2006 she moved to the University of Oxford in UK as a post-doctoral researcher where she worked in electron microscopy imaging and nanoanalysis of carbon and inorganic nanotubes and related materials. Since April 2009 she leads the Electron Microscopy Division in the ICN.

