First experiment at the ALBA synchrotron

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The ALBA Synchrotron Light Facility has begun to function as a research tool. Of the seven experimental beamlines scientists can use to analyse their samples, the first which has begun to work is the BOREAS line, addressed to studying materials through X-ray spectroscopy. The experiments are being conducted between 6 and 10 June with the aim of studying the magnetic behaviour of specific nanoparticles which improve the properties of superconductor tapes, so that they can transmit larger amounts of electricity more efficiently.

Researchers of the UAB (Universitat Autonoma de Barcelona) Department of Chemistry, Eduardo Solano and Josep Ros, together with researchers Jaume Gàzquez, Susagna Ricart and Teresa Puig of the Superconductors Group, Institute of Materials Science of Barcelona (ICMAB-CSIC), are studying the nanostructure of superconductor layers of superconductor ceramic material ($YBa_2Cu_3O_7$), incorporated with metal oxide nanoparticles. This material can be cooled down rather easily by using liquid nitrogen so as to maintain its superconductor properties and allows for the transfer of electricity from one point to another with a loss of almost no energy and an efficiency much greater than conventional electric cables; something which could revolutionise the way electric energy is transported.

Earlier experiments revealed that the presence of nanoparticles generated in situ in the layers substantially improved the superconductor capacity of the material since they made the magnetic vortices – spinning magnetic fields inside the superconductor – stick. This adherence produces a more efficient transport of electricity. In the study

currently being conducted, UAB and CSIC researchers are using low-cost chemical methods to prepare superconductor layers containing metal oxide nanoparticles which are mainly magnetic and have been previously prepared. In order to comprehend the influence these nanomaterials have on the behaviour of the superconductor material, researchers must discover the magnetic nature of the ions forming the nanoparticles both inside and outside the superconductor.

Researchers from UAB and from ICMAB-CSIC, together with ALBA scientist Manuel Valvidares, will study several samples with synchrotron light to discover exactly the magnetic properties of the nanoparticles of different types of ferrite and how these affect the attachment of vortices. After obtaining data, scientists will be able to optimise applications of ferrite nanoparticles to improve the properties of superconductor tapes.

The project is one of the fifty chosen out of 203 proposals presented for the seven beamlines. Of the proposals, 167 came from Spain, 30 from other European countries and the six remaining projects were sent from Asia and the United States.

ALBA, with a 50% participation between the Spanish and Catalan governments, is a particles accelerator measuring 270 metres in perimeter. Through its beamlines, electrons travel at near-light speed, at the precise energy of 3GeV, which produces an electromagnetic radiation used to view samples at atomic and molecular level and to analyse the structure of matter. There are a total of seven beamlines, each specialising in a different experimental technique.

In 2012, in the first call opened to users, nearly 300 research groups and over 600 individuals registered; figures ALBA Synchrotron members consider to be highly successful. The beamlines most on demand, in number of proposals, were those specialising in "protein crystallography" and in "materials science" (specialising in the diffraction of dust

technique). With less proposals but a higher number of requested access hours were the soft X-ray beamlines, dedicated to the study of the surface of different materials and their interactions, and the study of materials with magnetic and ferroelectric properties (the BOREAS beamline which is now being put into function). The amount of proposals received places the ALBA Synchrotron at the same level as other similar science facilities.

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