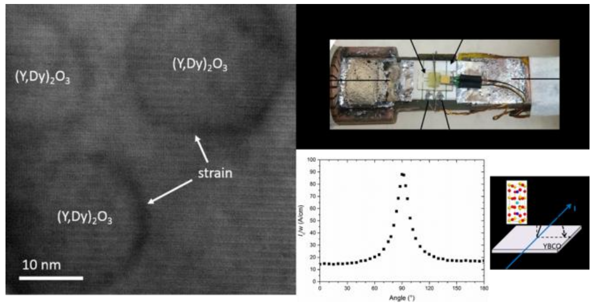
Higher performance high temperature superconducting tapes



Background

Among the few high temperature superconductors that can be used at liquid nitrogen temperatures, those based on the $YBa_2Cu_3O_7$ structure are by far the most promising for power applications involving high magnetic fields. Nevertheless, there is still a need for enhancing the performance of these materials in view of devices such as windmill generators that require fields of 4T or more. Using a mixture of various rare-earths instead of Y is known to yield promising results for superconducting levitation. We would like to explore the potential of such element combinations for improving the critical current density of the long wires necessary for power cables, transformers, high field magnets, etc. especially under working conditions involving high magnetic fields.

The aim of this project is therefore to explore the best ways of engineering $(Nd,Sm,Eu,Gd)Ba_2Cu_3O_7$ films to optimize the defect landscape in view of maximum performance under magnetic fields in excess of 4T. For this purpose, you will try to manufacture thin films with a high degree of preferential microstructural orientation and introduce suitable artificial defects able to withstand the drift of the magnetic field flux lines penetrating the superconductor under operating conditions.

During this project you are going to:

-Synthesize $(Nd,Sm,Eu,Gd)Ba_2Cu_3O_7$ high temperature superconducting films by chemical solution deposition on single crystal substrates.

-Conduct microstructural characterization of your samples by means of X-ray diffraction, optical and electron microscopy.

-Perform magnetization measurements at cryogenic temperatures under magnetic field to evaluate the superconducting performance of your samples.

-Analyze your experimental results using state of the art theoretical models.

Learning objectives:

At the end of this project you will be able to:

-Use various experimental characterization tools (X-ray diffraction, electron microscopy, magnetization measurements) and explain their basic principles as well as limitations.

-Critically evaluate your results.

-Draw links between microstructure and performance.

-Perform an efficient literature search and compare your own results to published data.

-Present your results to a scientific audience under conditions equivalent to an international conference.

-Write the draft of a scientific publication.

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