Title: Improving the performance of MgB_2 superconductors

Background

The development of superconducting MgB_2 wires has reached a level that enables their use in a few niche applications like for example MRI magnet systems. However, in order to exploit the full potential of this material, further improvements of its critical current density (j_c) are necessary, especially under working conditions involving high magnetic fields. This can be achieved by engineering defects at the nanometer scale or tuning some superconducting parameters of MgB_2 by suitable doping. An ideal solution would be to do both simultaneously.

The aim of this project is to explore the best ways of doping the MgB_2 superconductor with carbon while also creating nanoparticle inclusions in the material in order to boost its performance under magnetic fields in excess of 2T in view of applications such as windmill generators or fusion reactors.

During this project you are going to:

-Manufacture MgB_2 superconductors in the form of bulk polycrystalline samples or elongated wires.
-Conduct microstructural characterization of your samples by means of X-ray diffraction, optical and electron microscopy.
-Perform magnetization measurements at cryogenic temperatures 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.