Anelastic characterization of MgB$_2$ doped with carbon elements

M.R. da Silva$^1$, D. Rodrigues Jr$^2$, C.R. Grandini$^1$

$^1$UNESP, Laboratório de Anelasticidade e Biomateriais, 17.033-360, Bauru, SP, Brazil
$^2$USP, EEL, Departamento de Engenharia de Materiais, 12.602-810 Lorena, SP, Brazil

The discovery of the superconductivity of MgB$_2$ was of great importance, because this material is one of the few known binary compounds that have one of the highest critical temperatures [1]. As MgB$_2$ is a granular compound, it is fundamentally important to understand the mechanisms of the interaction of the defects and the crystalline lattice, in addition to the eventual processes involving the grain boundaries that compose the material [2]. In this sense, the mechanical spectroscopy measurements constitute a powerful tool for this study, because through them we can obtain important information about phase transitions, the behavior of interstitial or substitutional elements, dislocations, grain boundaries, diffusion, instabilities, and other imperfections of the lattice [3,4]. The samples were prepared by powder in tube method (PIT) reaction of Mg, B and the dopants in a sealed stainless steel tube, at 850 °C for 2h. The final dimensions of the bars were 40x30x3mm$^3$. After that the samples were characterized by density, x-ray diffraction (XRD), scanning electron microscopy (SEM) and electrical resistivity measurements. The density measurements are in great agreement with literature [5], although the samples show a considerable degree of porosity. In the XRD measurements, it was observed all the characteristic peaks of the “honeycomb” structure of the material. Although the MgO characteristic peaks were observed, their presence at this phase did not change the superconducting properties of the sample. By a qualitative analysis of the SEM microographies, it can be observed a material with a large number of pores, besides the coexistence of open and closed pores. This large number of pores is due to the processing and is responsible for the low mechanical resistance of the compound, making it very fragile. The electrical resistivity for all samples is near from 39 K. The mechanical spectroscopy spectra show the presence of almost four relaxation processes, which were explained by the interaction between several kinds of defects and the lattice.

Keywords: Anelasticity, MgB$_2$, carbon compounds

Financial support: CNPq e FAPESP.


e-mail: kirvis@fc.unesp.br