Microstructural characterization of a superconducting MgB_2/Si thin layer

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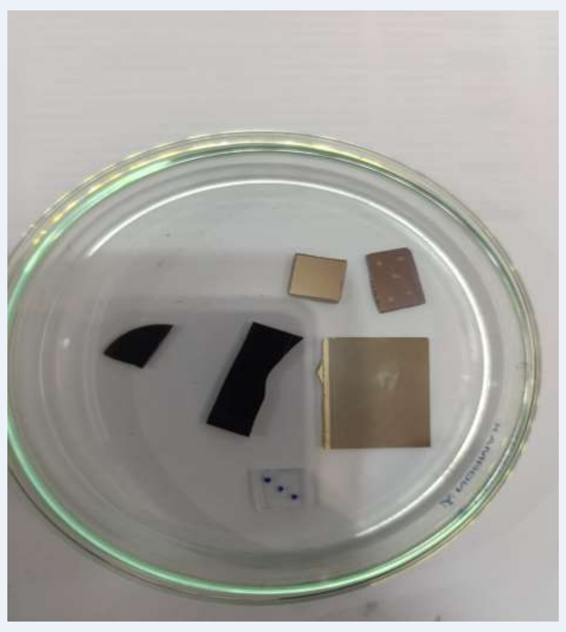
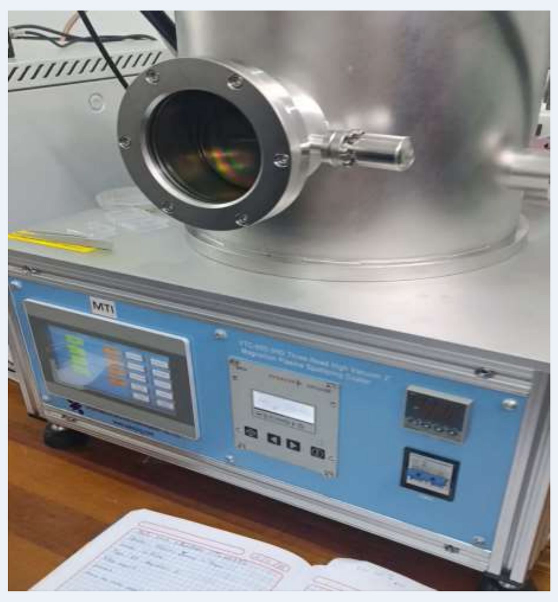
Introduction

The characterization of a thin superconducting MgB_2 layer deposited on a silicon substrate by magnetron sputtering involves the use of several advanced techniques to determine its structural and morphological properties. X-ray reflectivity (XRR) provides precise information on the thickness, density, and roughness of the layer, revealing a well-defined interface between MgB_2 and silicon. X-ray diffraction (XRD) is used to analyze the crystalline structure and preferred grain orientation, confirming the formation of the desired superconducting phase and enabling the estimation of crystallite size and residual stress in the film. Atomic force microscopy (AFM) provides detailed images of the surface topography, showing a homogeneous surface with low roughness and a uniform grain distribution. Finally, scanning electron microscopy (SEM) offers information on the morphology and grain size, as well as the quality of the coverage over the substrate. Taken together, these analyses confirm that the MgB_2 thin film grown by magnetron sputtering exhibits excellent structural and surface properties, making it suitable for applications in advanced superconducting devices.

Methodology





Conclusions

1. Polycrystalline MgB_2 layers were successfully grown using magnetron sputtering.

2. The thin films exhibit a broad absorption band spanning the entire visible region of the electromagnetic spectrum.

3. The thicknesses were approximately 150 nm, obtained through AFM profilometry.

4. The thin films have an average roughness of XX nm.

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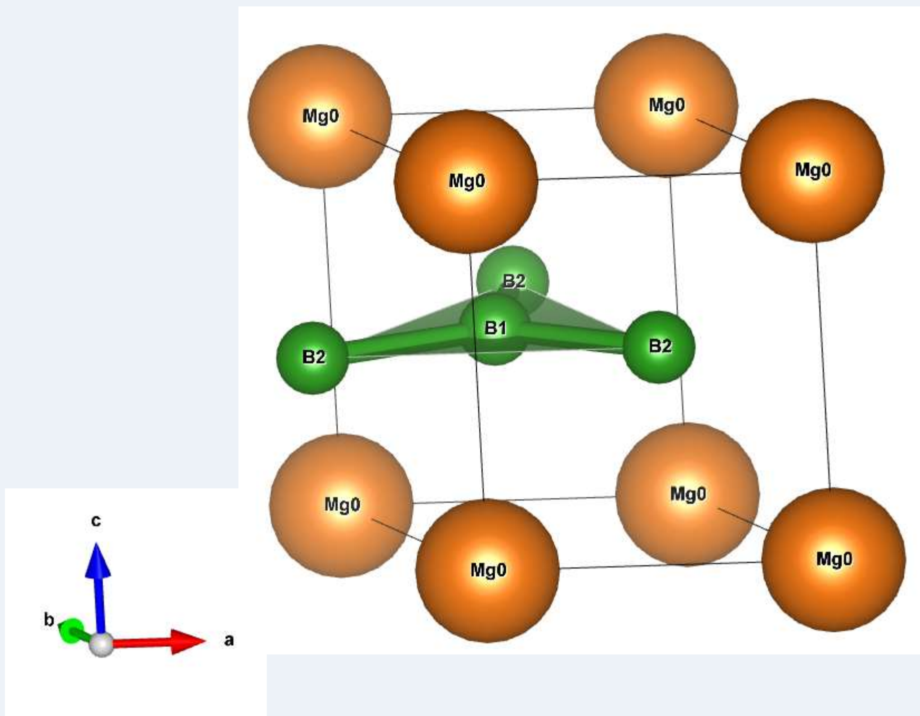
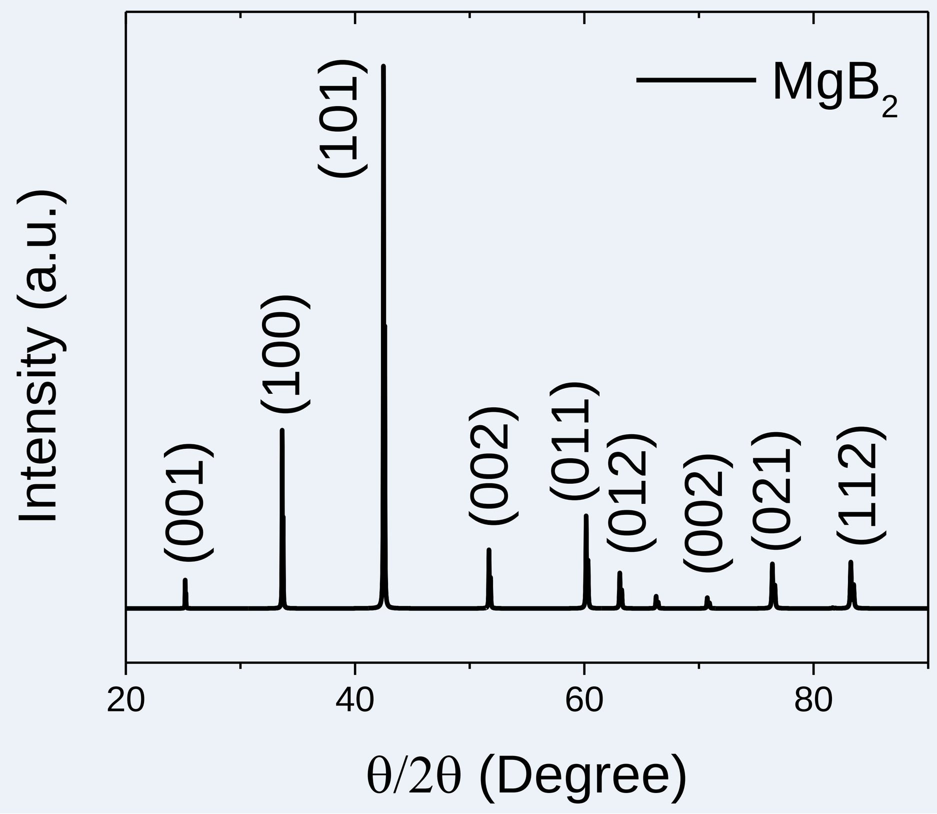
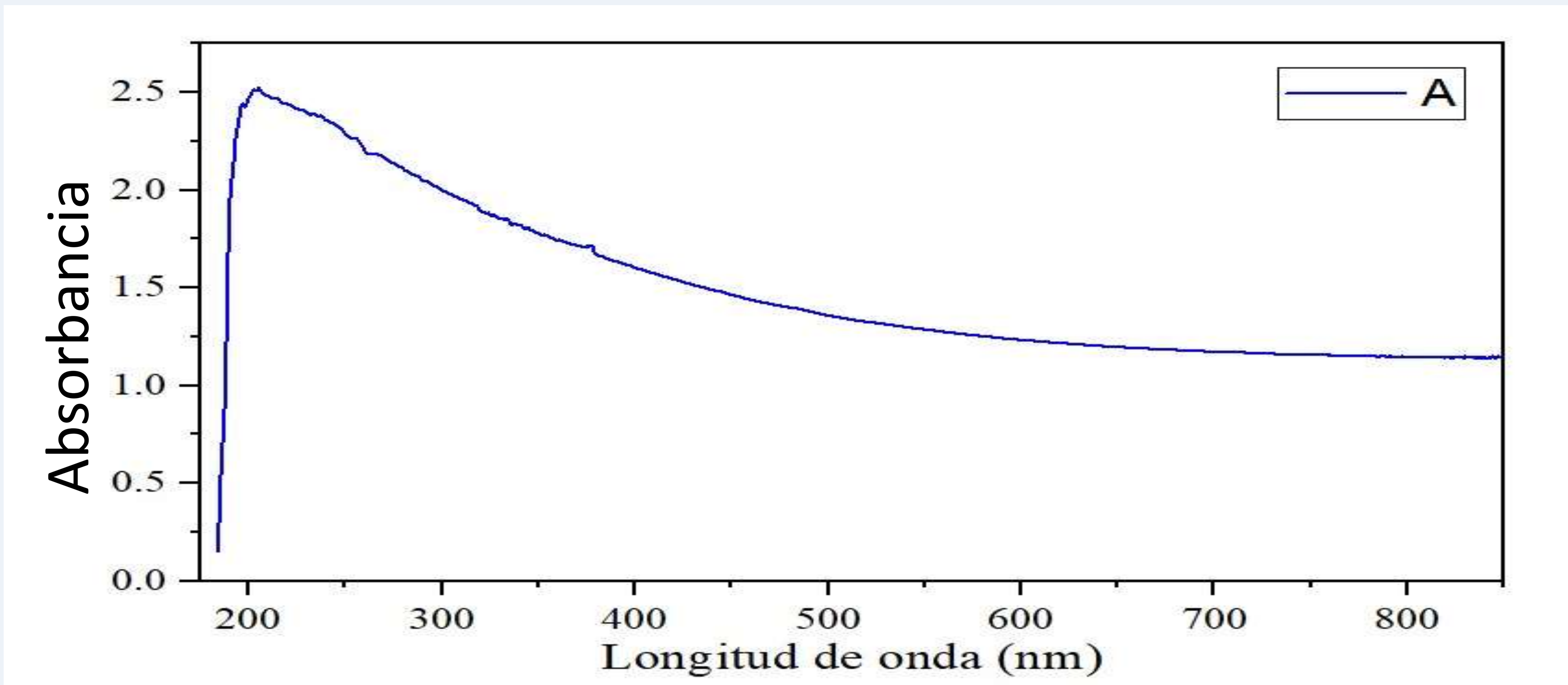
Results and discussion







Thickness and topography measurements with AFM