

# DEVELOPMENT AND CHARACTERIZATION OF $\text{MgB}_2$ SUPERCONDUCTING WIRE

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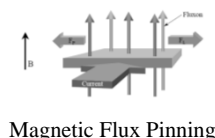
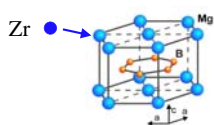
## ABSTRACT

The high values of  $\text{MgB}_2$  intrinsic properties, such as the upper critical magnetic field (40 T) and critical temperature (39 K), creates the possibility to use this material for applications in high fields, including due to the low cost of the raw materials. The goal of this work is to develop a route to produce an  $\text{MgB}_2$  superconducting wire, since the primary powders preparations to final heat treatment of sinterization.  $\text{TaB}_2$  and  $\text{SiC}$  is mixed with  $\text{MgB}_2$  powder, on an attempt to enhance the flux pinning and the material's transport capacity. The  $\text{MgB}_2$ +additions powder was prepared using high energy ball milling to mix and refine the grains, and then it was packed inside of niobium and monel (CuNi) tubes, using the powder-in-tube (PIT) technique. The final superconducting wire is composed by 42 filaments of  $\text{MgB}_2$ . The characterization of the samples heat treated in different temperatures and times show the microstructure and phase distribution in their cross sections, along with some superconducting properties and characteristics.

## INTRODUCTION

Increase critical current density,  $J_c$

- ✓ Grain boundaries
- ✓ Connectivity
- ✓ Crystalline defects
- ✓ Porosity
- ✓  $\text{MgO}$
- ✓ Doping



Magnetic Flux Pinning

## EXPERIMENTAL PROCEDURE

### POWDER PREPARATION

Powders:

$\text{MgB}_2 + \text{TaB}_2$  (2at.%) +  $\text{SiC}$  (10wt.%) + Mg excess (5at.%)

High Energy Ball Milling

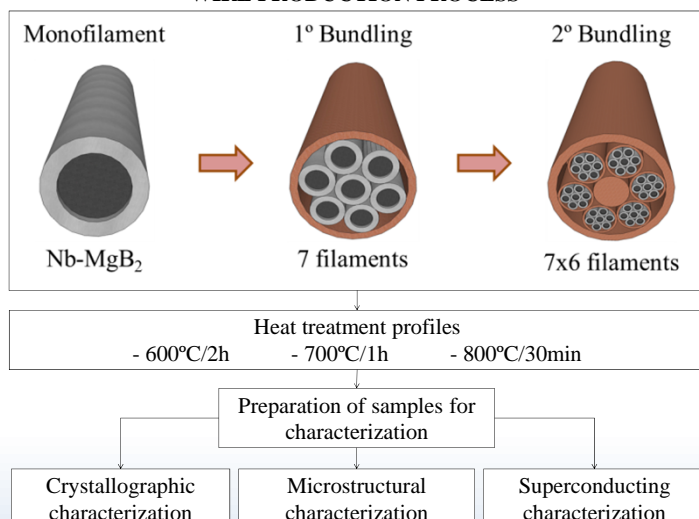


Glove-box (argon)



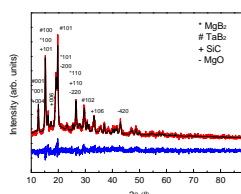
High energy ball mill (SPEX 8000D)

### WIRE PRODUCTION PROCESS



## RESULTS AND DISCUSSION

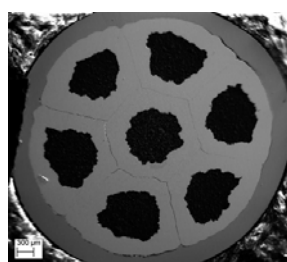
### CRYSTALLOGRAPHIC CHARACTERIZATION



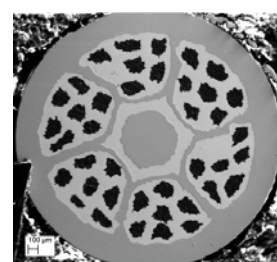
#### Structural phases refinement

Phases	Composition (wt.%)	a (Å)	b (Å)	c (Å)	Particle size (nm)
$\text{MgB}_2$	37.8	3.094	3.094	3.527	12.10
$\text{TaB}_2$	4.5	3.103	3.103	3.233	15.11
$\text{SiC}$	6.8	3.080	3.080	15.177	53.92
$\text{MgO}$	50.9	4.173	4.173	4.173	12.10

### MICROSTRUCTURAL CHARACTERIZATION

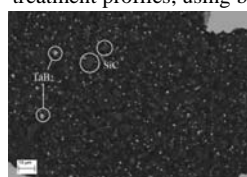


1° Bundling

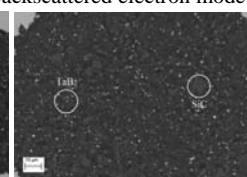


2° Bundling

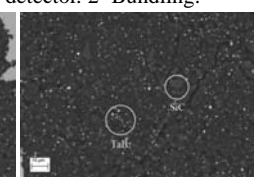
Microstructure of  $\text{MgB}_2$ +additions matrix for samples after different heat treatment profiles, using backscattered electron mode detector. 2° Bundling.



600°C/2h

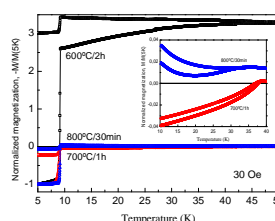


700°C/1h



800°C/30min

### SUPERCONDUCTING CHARACTERIZATION



DC magnetization curve as a function of temperature, for different profiles of heat treatment.

## CONCLUSION

It was possible to develop a homogeneous multifilamentary  $\text{MgB}_2$  superconducting wires using the powder-in-tube (PIT) technique and a combined mechanic deformation with swage and wire drawn. The microstructural characterization shows that the mechanical production process is efficient, maintaining the cylindrical geometry and intact diffusion barriers. The Nb barriers were effective against the Cu diffusion. Crystallographic characterization showed the large amount of  $\text{MgO}$  phase in the initial powder.

This work is related to the preliminar results about the  $\text{MgB}_2$ +additions wire, the superconducting characterization demonstrated that the heat treatment and  $\text{MgO}$  grown still requires optimization.

## ACKNOWLEDGEMENTS

