Microsc. Microanal. 18 (Suppl 5), 2012

doi:10.1017/S1431927612013128

Electrical polarization effect on $Bi_2Ca_2Co_{1.7}O_x$ thermoelectrics grown by laser floating zone

N. M. Ferreira*, Sh. Rasekh**, A. J. S. Fernandes*, F. M. Costa*, M. A. Madre**, J. C. Diez** and A. Sotelo**

* i3N, Dep. of Physics, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal
** ICMA (CSIC-Universidad de Zaragoza), Dpt. Ciencia de Materiales, Maria de Luna, 3. 50018 Zaragoza, Spain

Thermoelectric ceramic materials for practical applications must present high thermopower and relatively low electrical resistivity along with high chemical stability at high temperatures. These properties can be found in thermoelectric ceramics, for example in misfit cobaltites. These materials possess a high crystallographic anisotropy which is reflected on their thermoelectric properties [1]. Therefore, controlling their grains orientation is mandatory in order to achieve better performance for practical applications. In this perspective, texturing methods can play an important role for enhancing the final properties of the bulk materials.

The application of an electrical field during crystal growth by the laser floating zone method (EALFZ – Electrically Assisted Laser Floating Zone) has already proved to be an effective method to enhance crystal orientation on high critical temperature superconductor materials, resulting on electrical properties improvement [2]. Hence, a similar approach is here attempted in the growth of Bi2Ca2Co1.7Ox thermoelectric compounds. Samples have been grown under direct and reverse electrical polarizations and compared with samples grown without current (I = 0 mA), as a reference, in terms of their crystalline orientation.

The results revealed that when the positive pole was connected to the seed (I+ = direct current), better grain orientation is obtained, compared with samples grown without current. Furthermore, increasing the current, up to 300 mA, leads to enhanced grain alignment (Figure 1 – left). On the contrary, samples grown with the negative pole on the seed (I- = reverse current), showed no preferential crystalline orientation (Figure 1 – right). The XRD crystallographic figures shows thermoelectric phase orientation quality and quantity comparison on the samples prepared under zero and direct electrical polarization currents (Figure 2) For the samples with reverse current wasn't able measure signal due to non-grain alignment.

Moreover, at high currents (-300 mA) Bi metallic material expelled off the fibre can be observed (Figure 3). Therefore, EALFZ has been proved to be an effective route for enhancing grain orientation on misfit cobaltite thermoelectric ceramics when direct polarization is applied.

References

1. A. Sotelo, E. Guilmeau, Sh. Rasekh, M.A. Madre, S. Marinel, J.C. Diez, J. European Ceramic Society 30: 1815, 2010
2. F.M. Costa, M.F. Carrasco, N. Ferreira, R.F. Silva, J.M. Vieira, "LFZ fibre texture modification induced by electrical polarization", Physica C-Superconductivity and its applications 408: 915-916 Aug 2004

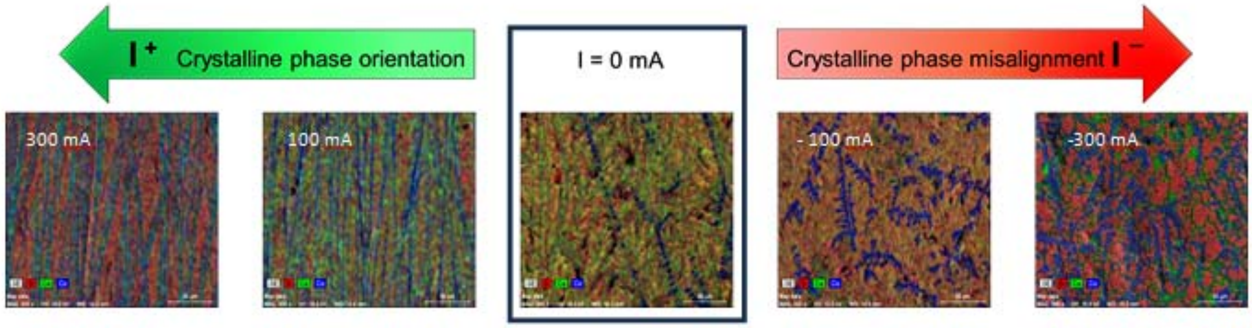

Figure 1. SEM/EDS mapping of longitudinal sections of Bi2Ca2Co1.7Ox fibres grown under direct (left) and reverse (right) current.

a)

	Intensity	Color
1	44.54	
3	103.63	
5	162.72	
7	221.81	
10	310.45	

b)

	Intensity	Color
1	53.25	
3	124.75	
5	196.25	
7	267.75	
10	375.00	

Figure 2. XRD crystallographic pole figure of Bi2Ca2Co1.7Ox fibre grown at: a) without current (I = 0 mA) and b) direct current (I+).

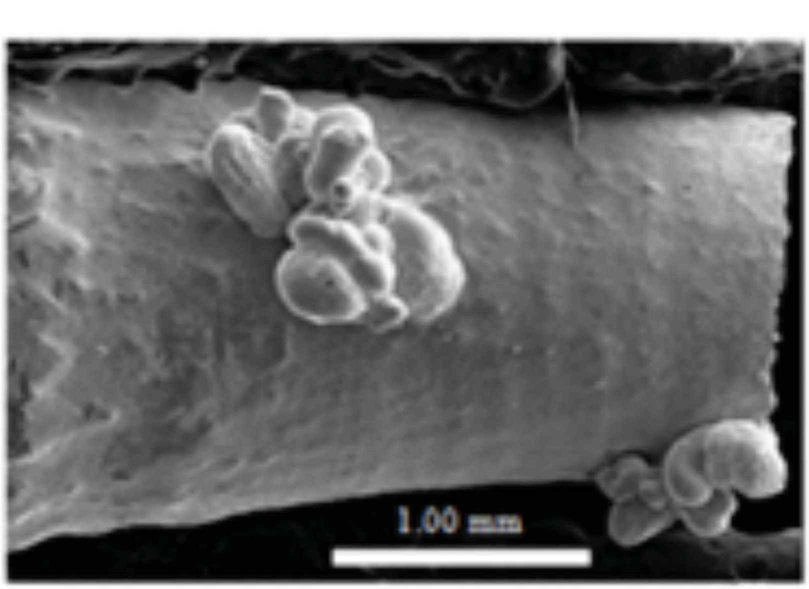

Figure 3. SEM detail of Bi rich protrusions on the longitudinal surface of a Bi2Ca2Co1.7Ox fibre grown at high current (300 mA) under reverse polarization.

https://doi.org/10.1017/S1431927612013128 Published online by Cambridge University Press