New opportunities for low cost nanostructured Coated Conductors for superconducting power applications

X. Obradors[1]
T. Puig[1], J. Banchewski[1], S. Rasi [1,2], A. Queralto[1], K. Gupta[1], L. Saltarelli[1], D. Garcia[1, 3], A. Pacheco[1], R. Vlad[1], L. Soler[1], J. Jareño[1], R. Guzmán[1], N. Chamorro[3,1], S. Ricart[1], J. Farjas[2], P. Roura[2], C. Mocuta[4], R. Yanez[3], J. Ros[3]

[1]Institut de Ciència de Materials de Barcelona, ICMAB-CSIC, Campus de la UAB, 08193 Bellaterra, Catalonia, Spain
[2] GRMT, Department of Physics, University of Girona, E17071-Girona, Catalonia, Spain
[3] Departament de Química, Universitat Autonoma de Barcelona, Campus UAB, 08193 Bellaterra, Catalonia, Spain
[4] Diffabs beamline, Soleil Synchrotron, Paris, France

xavier.obradors@icmab.es

Abstract

Coated conductors of $YBa_2Cu_3O_7$ (CC-YBCO) have emerged as the most attractive opportunity to reach unique performances in an extended range of temperatures and magnetic fields making them attractive for power (cables, generators, motors, fault current limiters) and magnet applications (high energy physics, fusion, magnetic resonance). Reducing the cost/performance ratio, however, continues to be a key objective. Chemical solution deposition (CSD) is a competitive cost-effective technique which has been used to obtain nanocomposite films and CCs. However, the typical growth rates (0.5-1 nm/s) of the fluorine-based CSD approach remain too low thus limiting its throughput.

We will show in this talk how CSD-based nanocomposite YBCO films can be obtained using metalorganic colloidal solutions including preformed $BaMO_3$ (M=Zr, Hf) perovskite nanoparticles. This approach can be easily combined with Inkjet printing and other scalable deposition techniques for thick film preparation. We will also show that combinatorial chemistry and high throughput experimentation approaches can be performed using CSD.

Transient Liquid Assisted Growth (TLAG) is a novel growth approach [1] allowing to combine the already well established CSD methodologies with ultrahigh growth rates based on a non-equilibrium liquid-mediated approach (100-1000 nm/s). This novel approach uses fluorine-free metalorganic precursors and is also compatible with the colloidal solution approach to nanocomposite coated conductors. We will show that using properly TLAG requires to generate new knowledge about kinetic phase diagrams that we have reached using fast in-situ XRD analysis (100 nm/frame) under synchrotron radiation [1, 2, 3]. Critical current densities up of 5 MA/cm^2 at 77K are already realized in thin films and the suitability of using IBAD buffered metallic substrates will be also demonstrated. A modified nanostructure is demonstrated based on the epitaxial nanoparticles thus generating a new opportunity to deeply analyse the key influence of defect structure on vortex pinning of nanocomposite superconductors.

REFERENCES

[1] Soler, L.; Jareno, J.; Banchewski, J.; Rasi, S.; Chamorro, N.; Guzman, R.; Yanez, R.; Mocuta, C.; Ricart, S.; Farjas, J.; Roura-Grabulosa, P.; Obradors, X.; Puig, T.; Nature Communications11, 344 (2020)

[2] S. Rasi, L. Soler, J. Jareño, J. Banchewski, R. Guzman, C. Mocuta, M. Kreuzer, S. Ricart, P. Roura-Grabulosa, J. Farjas, X. Obradors, T. Puig; J. Phys. Chem. C 124, 15574 (2020)

[3] A, Queraltó, J. Banchewski, A. Pacheco, K. Gupta, L. Saltarelli, D. Garcia, N. Alcalde, C. Mocuta, S. Ricart, F. Pino, X. Obradors, T. Puig; ACS Appl. Mater. Interfaces 13, 9101 (2021)