Contribution ID: **491** Type: **Regular Oral (15m)**

Oxygenation under high pressure of EuBCO and GdBCO coated conductors

Tuesday 23 July 2024 11:15 (15 minutes)

REBCO (Re=Y, Eu, Gd) coated conductors (CC) based on biaxially textured, thick and homogeneous nano-engineered multilayer structures opened up new application opportunities, such as dissipation-free energy transmission in superconducting grids, highly efficient engines for electrical aviation or compact fusion reactors beyond ITER. However, current carrying capacities of CC could be further improved because they are still far from theoretical limits. Overdoping by oxygen the REBCO structure of CC is one of the possible robust ways to increase current carrying capacity of CC, however overdoping these materials is not easy. Here we report on the high pressure oxygenation results from EuBCO-CC (with the surface Ag layer chemically removed) and GdBCO-CC (coated with 2 microns Ag layer). Oxygen pressure were in the range from 1 - 160 bar and temperatures between 300-800 ℃. The layers were characterized by XRD (estimating unit cells parameters), superconducting properties (Tc, Jc (T) and Jc(H, 77K)), and SEM, EDS and quantitative Auger spectroscopy. The highest Jc (77 K, 0 T) of 2.67 MA/cm2 was obtained by GdBCO-CC with c= 1.17310 nm oxygenated at 100 bar O2, 600 oC for 3 h. Its Jc (77 K, 0 T) was 4% higher than that of the initial GdBCO sample with c= 1,17351 nm. The Jc of the initial EuBCO-CC samples decreased after removing the Ag layer (Jc (77 K, 0 T)=1.38 MA/cm2). However, among the high pressure oxygenated EuBCO-CC, the highest Jc(77 K, 0 T)=1.31 MA/cm2 was that treated under 160 bar of O2 at 800 ℃ for 3 h. The approximate composition of EuBCO matrix phase (estimated after etching of its surface by Ar ions in the chamber of microscope) according to quantitative EDX analysis was EuBa2.06Cu2.89O7.35Ni0.11C1.05 and according to quantitative Auger analysis (which has higher locality than EDS) was EuBa0.57Cu0.25O0.54 The approximate stoichiometry of the matrix phase of EuBCO initial sample was EuBa2.05Cu3O7.97Ni0.12C (EDS) and EuBa0.74Cu0.22O0.72 (Auger). This suggests that high pressure oxygenation of EuBCO may induced anion and cation diffusion. Additional treatments and experiments on charge carrier density are on-going. We also investigated the time degradation process of EuBCO-CC with a chemically removed Ag surface layer when stored in air. It should be noted that the degradation of EuBCO-CC with a chemically removed surface layer after saturation with oxygen at 600 ℃ under a pressure of 100 bar for 3 h slowed down significantly.

We acknowledge funds from MICIU/AEI/FEDER for SUPERENERTECH (PID2021–127297OB-C21), FUNFUTURE "Severo Ochoa"(CEX2019–000917-S); MUGSUP (UCRAN20088) project from CSIC scientific cooperation with Ukraine; Catalan Government 2021 SGR 00440; NAS of Ukraine Project III-7-22 (0785).

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Session Classification: Tue-Or3

Track Classification: Tracks ICMC Geneva 2024: ICMC 05: Thin films, multilayers, electronics, materials, processing and properties