Highlights

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In-situ X-ray and neutron diffraction investigation of Bi-2212 in multifilamentary wires during thermal treatment

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Significant insights for critical current density (J_c) improvement in Bi-2212 superconductor wires can be obtained by an accurate analysis of the structural and microstructural properties evolving during the so-called partial-melt process, a heat treatment needed to improve grain connectivity and therefore gain high J_c. At this scope, we carried out an in-situ analysis by means of synchrotron X-ray and neutron diffraction performed, for the first time, during the heat treatment carried out with the very same temperature profile and reacting O_2 atmosphere in which the Bi-2212 wires are usually treated for practical applications. The obtained results show the thermal evolution of the Bi-2212 structure, focusing in particular on texturing and secondary phases formation. The role of the oxygen is discussed as well. Hence, the present investigation marks a significant advance for the comprehension of the phenomena involved in the wire fabrication process and provides useful insights for the process optimization as well.
The results in terms of secondary phase detection and grains texture are not only in full agreement with what is reported for state-of-the-art wires, but also add important insights for a further optimization of the process itself. It is now clear when and at which temperature the Bi-2201 phase forms and consequently how to avoid it. As already observed before, the Bi-2212 phase shows an in-plane and an out-of-plane texturing but the here presented results reveal as well that the texture originates from the nucleation of the Bi-2212 grains and does not evolve during the successive steps of the treatment. The role of the oxygen activity has been better clarified with the demonstration that this parameter rules the Bi-2212 texturing. These findings are of great importance for reducing the amount of secondary phases and improving the degree of texture, the two key parameters for obtaining high Jc values.
These results should furthermore promote the development of other HTS materials as isotropic wires through a similar process.

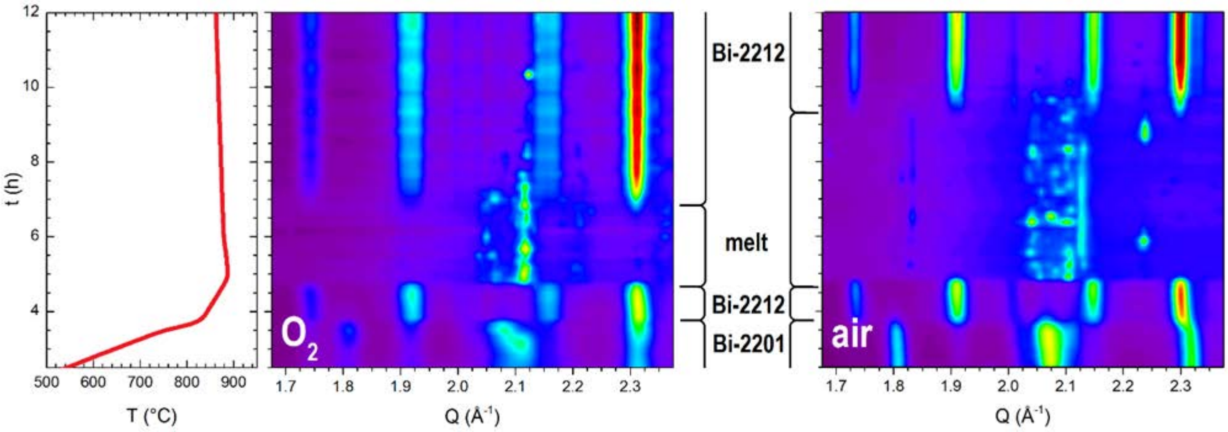

Fig. 1: Phase evolution in the multifilamentary wires during the first 12 hours of the thermal treatment in O2 (on the left) and air (on the right).