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M2Or3B-03 [Invited]: Advanced CSD-grown REBCO nanocomposites for high-field applications

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Most applications for REBa2Cu3O7-δ-based (REBCO, RE = rare-earth) Coated Conductors (CC) require reliable, cost-effective growth processes, but also a high performance in magnetic fields. The latter is addressed by the creation of flux pinning centres, e.g. in form of non-superconducting secondary phases (nanocomposites) or elemental mixing on the RE position. Chemical solution deposition methods, such as the TFA-MOD process using metal-organic trifluoroacetates as precursors or related low-fluorine approaches, can meet those requirements: The simplicity of the process allows cheap and versatile production of long tapes, composition and stoichiometry of the precursor solutions can be readily modified, and artificial pinning centres are conveniently introduced via the solutions. This facilitates an easy adaption of the CC performance to the demands of the according applications.
So far, YBCO has been the most-investigated compound since it has been the first with Tc above 90 K. It is also the most stable REBCO phase, yttrium is well available and amongst the rare-earth elements the least expensive. However, other RE elements promise further performance enhancements in consequence of higher Tc, but also process simplification and a higher reproducibility due to broader processing windows.
Here, we present our research on eight different single-RE-Ba2Cu3O7-δ compounds on different substrates, to clarify their Tc values when grown by MOD and to develop a deeper understanding of their processing windows (Tgrowth, p(O2)). All systems have been thoroughly investigated as pristine phases but also as REBCO-BHO nanocomposites for further pinning enhancement. Those investigations have been extended to several mixed species RE1-xRE'xBa2Cu3O7-δ and their nanocomposites. Promising candidates are, e.g., Y1-xGdxBa2Cu3O7-δ+BHO with Jc,sf(30 K) > 40 MA/cm² and Fp(30 K) > 220 GN/m³ beyond 14 T. A comparison of the resulting physical (Tc, Jc(B)T, Jc(Θ)B,T) and a correlation to their structural properties (XRD, SEM) will be discussed with regard to the underlying pinning mechanisms.

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