Upper Critical Fields and Critical Current Densities of Fe-based Superconductors as Compared to Those of Other Technical Superconductors

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Abstract - Three years since the discovery by the Hosono's group of Fe-based superconductors, an enormous number of compounds, belonging to several different families have been discovered and fundamental properties have been deeply investigated in order to clarify the interplay between magnetisms and superconductivity in these compounds. Indeed, the actual potential of these compounds for practical applications remains still unclear.

Fe-based superconductors are midway between high temperature superconductors (HTSC) and MgB_2. In Fe-based superconductors the critical current is rather independent of the field, similarly to HTSCs, as a consequence of the exceptionally high upper critical field and strong pinning associated with nm-scale local modulations of the order parameter. They exhibit low anisotropy of the critical current with respect to the crystalline directions, as in the case of MgB_2, which allows current flow along the c-axis. However, Fe-based superconductor polycrystalline materials currently available still exhibit electromagnetic granularity, like the HTSCs, which suppresses superconducting current flow over long length. Whether the nature of such granularity is extrinsic, as due to spurious phases or cracks between grains or intrinsic, as related to misalignment of adjacent grains, is under debate. These aspects will be review in the light of the recent literature

Keywords – Fe-based superconductors, single crystals, thin films, granularity, upper critical fields, flux pinning, critical currents

Submitted to ESNF November 30, 2011; accepted Dec. 6, 2011.
Preprint of invited SCC paper submitted to *Physica C* (should be cited accordingly)
Reference No. ST293; Category 2