

AN OVERVIEW OF SUPERCONDUCTIVITY OF MgB_2 : CRITICAL CURRENT DENSITY, PINNING MECHANISMS, SCALING LAW AND LEVITATION FORCE

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Energy conservation and related environmental issues inevitably are the most serious problem of the 21st century. Superconductive technology is therefore, probably the ultimate and environment friendly technology for energy saving with its impact on almost all the aspects in our daily life. Large scale superconductive devices for power industry depend on conductors with high critical current densities at temperatures where the cost of coolant is affordable. High temperature superconductors (HTSCs), inter-metallic compound superconductor (MgB_2) and recently discovered pnictides (FeAs) are the ideal candidates for such applications. Although great progresses have been achieved since the discovery of HTSC, they could not be employed yet for large scale applications due to anisotropy and its high cost. Further, the presence of toxic arsenic and unstandardized wires/tapes fabrication techniques limits the applications of pnictides. Due to transparent grain boundaries, lower anisotropy, large coherence length, reasonably good critical current density (J_C), easy processing and low cost, MgB_2 has been the challenge for the domination of HTSC since the last one decade at LH2 temperature. However, the compound is far from being the perfect choice and still needs substantial improvement in its J_C , H_{C_2} etc. to become competitive. Fortunately, the structure of MgB_2 allows the control and improvement of H_{C_2} and J_C by appropriate chemical doping. This has led to a race for increasing J_C and drive it closer and closer to the depairing current density (J_d). However, a sufficiently high J_d does not guarantee a high J_C for the superconductor to be useful for engineering applications and hence one need to tailor the defect structure of the superconductors to maximize flux pinning force (FP). In the present talk, instead of highlighting our work on improving J_C of MgB_2 superconductor through inorganic and organic materials doping, emphasis has been given to understand and identify the pinning mechanisms, scaling law and levitation force of MgB_2 based superconductors.

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