A. Modification of the electromagnetic properties of MgB_2 superconductors by nano materials doping for high magnetic field application

Engineering of the electromagnetic properties of MgB_2 superconductors by simultaneous partial substitution of suitable nano materials at B site or Mg sites and inclusion of nano pinning centers by selective addition of nano materials. The partial substitution will increase the critical field (H_{C2}) of MgB_2 while the nano materials inclusion will enhance the pinning centers and hence critical current density (J_C) of it. The agglomeration of the nano particles is the main hurdle in the uniform distribution of it inside the MgB_2. Non uniformity of the inclusion is the main cause of limiting the J_C of the MgB_2 materials. An integral part of the future plan is to optimize the physical parameter in synthesis to enhance the dispersion of the nano materials inside the MgB_2.

B. Synthesis, characterization and engineering of nanocomposites of conducting polymer and carbon nanotube

The discovery of carbon nanotubes (CNTs) in 1991 has heralded a new era in the synthesis, development and application of advanced materials. An important class of advanced materials at the forefront of the nanotechnology is nano-composites of CNT and polymer, which offer an unprecedented potential due to the possibility of engineering their properties to suit specific applications. Of particular interest are conducting polymers that combine the anti-corrosion properties, ease of processing and flexibility of plastics with electrical and optical properties of metals and semi-conductors. However, the nanometric dimension and high aspect ratio of CNTs present an important challenge to the fabrication and processing of CNT-polymer composites, notably the uniform dispersion of CNTs throughout the polymer matrix. As a matter of fact, bundling, aggregation and agglomeration due to van der Wall attraction are major obstacles towards the realization of the technological potential of CNTs. Moreover, the prohibitive cost of CNTs is probably the single most important factor that is hampering its large-scale application.

Keeping in mind the above-mentioned limitations, our future plan is to add carefully selected cost-effective nano-additives in the CNT-polymer nano-composite that could improve the dispersion of CNTs in the polymer matrix, thereby enhancing its thermal and electrical conductivity as well as the strength even at low CNT concentrations. Engineering the properties of nano-composites to suit specific applications with the help of nano-additives is another important factor that will ultimately govern the choice of suitable nano-additives.