Analysis of high-Tc superconductor compounds on the nanometre scale

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Due to the small coherence lengths of the high-Tc compounds, effective pinning sites are defects or particles of nanometer size according to 3. Integral magnetic measurements of the magnetization as a function of temperature in large applied magnetic fields (up to 7 T) have revealed that practically all high-Tc compounds exhibit spatial inhomogeneities, which can be caused by either oxygen deficiency (YBCO), solid solutions of Nd/Ba (NdBCO and light rare earth 123-type compounds), intergrowths (Bi-based superconductors) or chemical doping by pair-breaking dopants like Zn, Pr, etc. Such local variations of the superconducting properties should be visible in low-temperature scanning tunneling microscopy experiments, and their effects on flux pinning could be studied in a direct way. Various irradiation experiments by neutrons, protons, and heavy-ions have enabled the artificial introduction of effective pinning sites into the high-Tc samples, thus creating many different observations in the integral magnetic data. Furthermore, several sub-structure formations are found in several multi-light rare earth 123-superconductor samples by means of AFM investigations, which may play an important role for the considerably improved critical current densities in these materials. From all these observations, we construct a pinning diagram explaining many features observed in high-Tc samples.