Nanoscale flux pinning sites in high-T_c superconductors

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Ideal flux pining centres in high-T_c superconductors should be of nanometre size as the coherence length, ☞, is so small. Therefore, the optimisation of high-T_c superconductor samples concerning high critical current densities and high flux pinning has to take place in the nanometre range. An important goal of the current research is to find specific preparation strategies to create such ideal flux pining sites already *during* the sample processing. By means of AFM and STM measurements at ambient conditions, we have investigated various samples of $YBa_2Cu_3O_x$ (YBCO), $NdBa_2Cu_3O_x$ (NdBCO), (Sm,Eu,Gd)$Ba_2Cu_3O_x$ (SEG) and (Nd,Eu,Gd)$Ba_2Cu_3O_x$ (NEG) superconductors. We find that the two systems with the highest critical current densities (NEG, SEG) and hence, the strongest flux pinning [1,2], exhibit microstructures on the nanometre scale which are remarkably different from those obtained in the YBCO system. The stripe-like growth structures are the key for the considerable improvements concerning the critical current densities especially at high magnetic fields and elevated operating temperature (77 K).

[1] A. Hu, N. Sakai, H. Zhou, M. Matsui, and M. Murakami, Supercond. Sci. Technol. 16 (2003) 33
[2] M. Muralidhar et al., Phys. Rev. Lett. 89 (2002) 237001

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