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Vortex pinning vs. superconducting wire network in nanostructured superconductors[1]

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Superconducting films with array of ordered defects allow studying effects which are governed by the interplay between lengths of the nanostructured sample and lengths related to physical parameters, as for example coherence length. When the coherence length and the separation between the defects are similar, the sample can mimic a superconducting wire network. In this situation, applied magnetic fields induce Little-Parks oscillations due to fluxoid quantization constraint. These L-P oscillations vanish when the coherence length is smaller than the "stripe" superconducting region between the defects. In superconducting films with array of nanodefects periodic oscillations can also be detected in resistance R(H), critical current I_c(H), magnetization M(H) and *ac*-susceptibility χ_{ac}(H) in a broader temperature range than the temperature interval where L-P oscillations are present. Vortex pinning mechanisms are the origin of these oscillations. These oscillations emerge due to matching effects between two lattices: the vortex lattice and the lattice of defects. These oscillations are detected in a broader temperature interval than the temperature interval where L-P oscillations are present. Worth to note that, due to the coherence length divergence at T_c, a crossover to wire network behavior is experimentally found always. Interestingly, both mechanisms coexist close to superconducting critical temperatures; i. e. in the temperature region where the sample mimics superconducting wire network. These overlapping effects can be experimentally separated and both origins can be discriminated. We have analyzed and single out, with magnetotransport measurements, both mechanisms: pinning and fluxoid quantization constraint in superconducting films with arrays of non-magnetic and magnetic dots.

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