Pinning Effects in Nb Thin Films with Artificial Pinning Arrays

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Abstract

We summarize some results on the behavior of vortex dynamics and pinning effects in superconducting films with artificial pinning centers. Superconducting thin films with regular arrays of holes were fabricated using electron-beam lithography and reactive dry etching techniques. Vortex dynamics in the mixed state in type II superconductors is strongly influenced by the presence of defects, which act as pinning centers. Periodic critical current matching peaks were observed in magnetotransport measurements. The matching effect is caused by the interplay between the pinning centers and vortex lattice. Therefore, vortex lattice behaviors are changed for different temperatures and the geometry of the pinning centers. Molecular dynamic simulations are made to study this phenomenon. The ground state distribution of vortices obtained from simulations can give a reasonable explanation of the prominent matching peaks we found in the experiments.

Keyword：Superconductors · Pinning arrays · Vortex