FLUX PINNING MODEL AND PINNING PRESSURE IN SUPERCONDUCTORS WITH RANDOMLY DISTRIBUTED COLUMNAR DEFECTS

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9.7 cm

We suggest a new phenomenological model of flux pinning in type-II superconductors with randomly distributed columnar defects. In a rigid two-dimensional vortex lattice three energies associated with (i) vortex-vortex interaction, (ii) pin-vortex interaction, and (iii) thermal fluctuations are taken into account. By free energy minimization we determine the equilibrium number of vortices pinned by a random pinning disorder, the associated pinning pressure, and the critical current density as a function of the applied magnetic field, temperature, and concentration of pins. A corporate action of pinning and shearing pressures can lead to appearance of the peak effect if the former is lower than the latter. Within the framework of the proposed model the field dependencies of the critical current density were calculated for various temperatures and defect concentrations. It was shown that with increasing temperature the peak on a Jc(B)-curve decreases and its position shifts to lower fields, in a good qualitative agreement with many experiments. Both the position and shape of the peak are sensitive to the average period of pins and temperature dependencies of the material parameters. We also demonstrate that the second peak is less pronounced when density of pins grows.

13.4 cm

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