Microwave-stimulated superconductivity in the vortex state

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In the mixed state of type-II superconductors penetrated by an external magnetic field in the form of a lattice of Abrikosov vortices, the dc resistance is known to increase with increasing velocity of the vortex lattice [1]. Accordingly, vortex pinning sites impeding the vortex motion are widely used to preserve the low-dissipative response of the system [2]. In our recent experiments we subjected superconducting Nb films with nanogrooves to a high-frequency ac current stimulus [3-5]. By tuning the number of mobile and pinned vortices by varying the magnetic field around the so-called matching values, Fig. 1, we observe a completely opposite effect [6]. Namely, the vortex-related microwave excess loss for mobile vortices becomes smaller than for pinned vortices in a certain range of power levels at ac current frequencies above 100 MHz. This is distinct from the well-known phenomenon of microwave-stimulated superconductivity in the Meissner state [7, 8]. Thus, our findings appeal for the development of a theory of microwave-stimulated superconductivity in the vortex state. Generalization of the theory is currently under way and the theoretical results soon will be presented in comparison with the experimental data.[1] E. H. Brandt, Rep. Progr. Phys. 58 (1995) 1465.

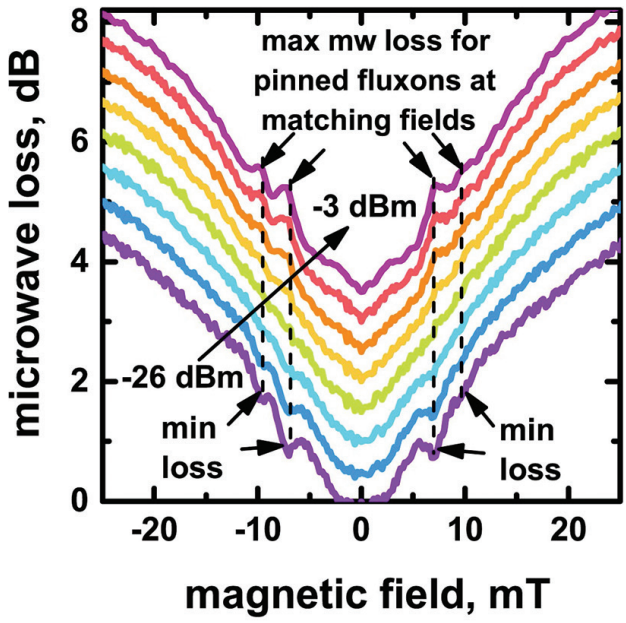

Fig. 1. Vortex-related microwave losses as a function of the magnetic field value for a series of microwave power levels, as indicated. While at lower ac power levels, the microwave loss is minimal at the so-called matching values *(7.2 mT and 9.6 mT)*, when the vortex lattice is commensurate with the periodic pinning nanostructure, at high power levels the minima turn into maxima indicating that pinned vortices dissipate less than the mobile ones.

References

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