Controlling flux flow dissipation by changing flux pinning in superconducting films

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The study of the flux flow state in superconducting materials characterized by rather strong intrinsic pinning, such as Nb, NbN, and nanostructured Al thin films, has been done by driving the superconducting dissipative state into the normal state by current biasing. Vortex pinning strength has been changed either by ion irradiation, by tuning the measuring temperature or by including artificial pinning centers. Maximum pinning does not always correspond to highest stability of the superconducting state. Indeed measurements of critical flux flow voltages for all materials show the same effect: switching to low flux flow dissipations at low fields for an intermediate pinning regime. This mechanism offers a way to extend the stability of the superconducting state just above Jc, which may be of significant interest to technological applications. This work stresses the relevance of the disorder and pinning at the microscopic scale to determine the vortex depinning transition. In addition, it demonstrates that vortex instability transitions are strongly affected by pinning, a feature that has escaped to most of the theoretical works until now. Therefore, our results will encourage researchers to look beyond Jc, and widen the range of currents above Jc where low dissipation can be sustained.