

Plastic Depinning in a Sheared Vortex System with Random Pinning

A. Motohashi and S. Okuma

Department of Physics, Tokyo Institute of Technology, Tokyo, Japan

A plastic depinning phenomenon¹ is studied in a sheared vortex system in a Corbino-disk superconductor with random pinning, where some vortices are mobile while others remain pinned. We measure the time-dependent voltage $V(t)$, which is proportional to the average vortex velocity, just after the dc current I with a sharp rise is suddenly applied to the vortex system. We find decaying $V(t)$ toward the steady-state voltage, indicating that the moving vortices are gradually pinned. The decay time $\tau(I)$ diverges at around a depinning current, as determined from the static $I - V$ characteristics.² By changing the field sweep process prior to measurements as well as the field strength itself, we have changed the initial vortex configuration, namely, the number of pinned vortices. It is found that the value of τ is dependent on the initial vortex configuration, while the critical dynamics is insensitive to it. The results provide a strong support for the view that plastic depinning is a nonequilibrium phase transition. We also suggest that the depinning transition falls into the same universality class as the absorbing transition.

¹C. Reichhardt and C.J. Olson Reichhardt, Phys. Rev. Lett. **103**, 168301 (2009).

²S. Okuma, Y. Tsugawa, and A. Motohashi, Phys. Rev. B **83**, 012503 (2011).