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Vortex Matter in nano-structured superconductors KAZUTO HIRATA, AJAY THAKUR, SHUICHI OOI, TAKASHI MOCHIKU, National Institute for Materials Science — We have fabricated anti-dots array in Nb and NbN, and high-T_c superconductor Bi-2212 with the diameter of r and the spacing of a , and have measured the flow-resistance of vortices perpendicular to the array and magnetic field. Depending also to the ratio of r/a , we can produce a variety of vortex-matching effect; the usual and the fractional matching. In low-T_c superconductors, the usual matching effect shows “dips” in the flow resistance at the matching field. However, it shows “humps” at higher magnetic fields, which may be related to the formation of giant vortices and interstitial vortices, depending on the ratio r/a . The matching phenomena seem to occur just like the Bloch electrons in two-dimensional electron system with crystalline lattice under magnetic field. The anti-dot array acts as a crystalline lattice to the vortices. In this case, vortex flow-resistance corresponds to T_c in the linearized GL equation. Generation and annihilation of the fractional matching effect might be well reproduced. In high-T_c superconductor, the matching effect is closely related to the first order vortex lattice melting of the pristine samples in the presence of the anti-dot arrays and with changing the potential energy of the vortex pinning.

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