Vortex Phases in Mesoscopic Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$ Single Crystals in Magnetic Fields Near \textit{ab}-plane

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YUIMARU KUBO, MASAHI KOHRI, KOHEI KAWAMATA, TAKASHI YAMAMOTO, ITSUHIRO KAKEYA, KAZUO KADOWAKI, Institute of Materials Science, University of Tsukuba, Tsukuba 305-8573, Japan — In order to study the vortex matter in the layered superconductors in magnetic fields parallel to the \textit{ab}-plane, we performed the in-plane resistivity and the \textit{c}-axis resistivity measurements on the bulk and mesoscopic Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$ single crystals. In the bulk samples, a boundary between the strong pinning phase and the weak pinning vortex phase was found at about 3° away from the \textit{ab}-plane, indicating possible crossover from the vortex chain + lattice phase into tilted (vortex chain) phase. The vortex phase in the parallel magnetic fields, exhibited a strongly non-Ohmic behavior, indicating the possible two-stage melting phase transition. It was found that the vortex lock-in transition in mesoscopic crystals, becomes considerably broad in high magnetic fields, while exhibiting the sharp features in low magnetic field region. The first penetration field of vortex pancakes demonstrates a nontrivial field dependence.

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