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Field dependence of the lock-in transition of Josephson vortex in $Bi_2Sr_2CaCu_2O_{8+\delta}$ mesoscopic crystals ITSUHIRO KAKEYA, YUIMARU KUBO, MASASHI KOHRI, TAKASHI YAMAMOTO, KAZUO KADOWAKI, University of Tsukuba, Tsukuba, Ibaraki 305-8573 Japan — We have investigated vortex states in magnetic fields close to the ab-plane of $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212) by means of the c-axis resistivity ρ_c in Bi2212 mesoscopic crystals fabricated by the FIB technique. When magnetic field $H \leq 1$T was tilted from the ab-plane at $T = 60$ K, a sharp drop in ρ_c was observed at an angle θ_{th} ($\theta = 0$ for $\mathbf{H} \parallel ab$-plane) depending on the field (typically θ_{th}=0.5 deg. for H =1T). ρ_c below θ_{th} does not depend on angle and is almost proportional to H, suggesting ρ_c being Josephson vortex (JV) flow resistivity. Above θ_{th}, it is considered that the JV flow is strongly impeded by pancake vortices (PVs), which attract with JVs and do not flow by the c-axis current, resulting in $\rho_c \approx 0$. Moreover, the penetration field of PVs $H \sin\theta_{th}$ decreases with increasing H. This is considered to be yielded by decrease of the line energy of pancake stacks due to the formation of the crossing lattice (CL). Therefore, the drop in ρ_c corresponds to the transition from the lock-in (LI) state to the CL state. At high magnetic fields, the decrease in ρ_c is broadened and has a shoulder structure. These results suggest that other vortex states between the LI and CL states emerge with increasing magnetic field and have intermediate JV viscosity. The expected vortex structures will be argued.

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