Quantitative Identification of the Flux-flow Modes in a Stack of Intrinsic Josephson Junctions of $Bi_2Sr_2CaCu_2O_{8+x}$ Single Crystals

Myung-Ho Bae and Hu-Jong Lee

Department of Physics, Pohang University of Science and Technology, Pohang 790-784, Republic of Korea

We observed the splitting of the flux-flow branches in the current-voltage characteristics of serially stacked intrinsic Josephson junctions (IJJs) formed in $Bi_2Sr_2CaCu_2O_{8+x}$ single crystals in the long-junction limit. A stack of IJJs with various geometries was sandwiched between two Au electrodes deposited on top and bottom of the stack using the double-side cleaving technique. In all the samples studied, the branch splitting started from about 2 T ranges, which corresponded to a dense vortex configuration, and became more distinct in a higher magnetic field range. This observation can be explained in terms of switching between different Josephson fluxon modes in resonance with the collective plasma oscillation modes induced by both inductive and capacitive coupling between stacked IJJs. This is the first detailed and quantitative identification of the coherent flux-flow modes in stacked IJJs in relatively high magnetic fields up to 5 T.

keywords : fluxon dynamics, intrinsic Josephson junctions, collective plasma oscillations, mode splitting, fluxon resonance steps