Size-dependent transformation from triangular to rectangular fluxon lattice in Bi-2212 mesa structures

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We present a systematic study of the field and size dependencies of the static fluxon lattice configuration in Bi-2212 intrinsic Josephson junctions and investigate conditions needed for the formation of a rectangular fluxon lattice required for a high power flux-flow oscillator. We fabricate junctions of different sizes from $Bi_2Sr_2CaCu_2O_{8+x}$ and $Bi_{1.75}Pb_{0.25}Sr_2CaCu_2O_{8+x}$ single crystals using the mesa technique and study the Fraunhofer-like modulation of the critical current with magnetic field. The modulation can be divided into three regions depending on the formed fluxon lattice. At low field, no periodic modulation and no ordered fluxon lattice is found. At intermediate fields, modulation with half-flux quantum periodicity due to a triangular lattice is seen. At high fields, the rectangular lattice gives integer flux quantum periodicity. We present these fields in dependence on the sample size and conclude that the transitions between the regions depend only on $\lambda_J(J_c)$ and occur at about 0.4 and 1.3 fluxons per λ_J, respectively. These numbers are universal for the measured samples and are consistent with performed numerical simulations.