THz wave emission from intrinsic Josephson junctions controlled by surface impedance and in-plane magnetic field: Numerical study

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THz wave emission from intrinsic Josephson junctions was confirmed without external magnetic fields,[1] and the surface impedance Z was found out to play a crucial role.[2] Various emission states such as the in-phase state or π-phase-kink states are characterized by dynamical phases controlled by the bias current and Z. When the in-plane magnetic field is introduced, field dependence of emission intensity also strongly depends on Z. Cavity resonance modes are stabilized for $Z \geq 3$, and the fundamental mode gives the strongest emission. As the in-plane magnetic field increases for a fixed number of junctions, dynamical phase transitions seem to occur between the π-phase-kink state, various incommensurate-phase-kink states, and in-phase state. As Z varies, a crossover of the field profile of emission intensity takes place for $Z \approx 50$ between characteristic peaks for smaller Z and monotonic decrease for larger Z. The double-peak structure reported in a recent experiment [3] can be explained for $Z = 30$ by finite-size analysis with respect to number of junctions. The critical in-plane field between the π-phase-kink and incommensurate-phase-kink states converges to zero as the number of junctions increases, while characteristic emission peaks remain nonvanishing for finite in-plane fields.

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[2] Y. Nonomura, Phys. Rev. B **80**, 140506(R) (2009). [3] K. Yamaki *et al.*, Physica C **470**, S804 (2010).