

Interaction between Abrikosov and Josephson Vortices Induced by Microwave Magnetic Field and External Magnetic Field in Bi2212 Crystal: Vortex Dynamics under Crossing Field

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Reentrant phase (RP) was proposed by Fisher and Nelson for strong two dimensional high T_c superconductors. Due to less interaction between 2D pancake vortices at low fields, there is Liquid-RP just above Meissner phase under Solid mixed phase. It is very difficult to detect this RP experimentally because it is quite narrow. The vortex phase is concerning to mobility of vortex, then we tried to detect this RP employing modulated microwave absorption (MA) technique utilizing induced vortex dynamics due to high-frequency modulation field. The MA vs field (H) spectrum for $H//c$ shows only a sharp first peak: P1 arising from Meissner state at low field at well low temperatures (T). At some higher T, it shows a Dip just above P1 and following Broad peak: Pb. The Dip and Pb arise from the Liquid-RP and Solid phase, respectively. At much higher T, the Dip and Pb disappear because it approaches to critical temperature. From these results of MA vs T, we can obtain RP experimentally. It exhibits a narrow entrance of RP which is strictly similar to the theoretically proposed RP.

Microewave power (Pm) dependence of MA was obtained for $H//c$ at low T. The Dip and Pb appear at higher Pm and they shift to low field with increasing Pm. Their sharp drops in rather low Pm region are explained by sample temperature rise. However, their gradual drops in much higher Pm region is interpreted by vortex interaction between Abrikosov Vortex induced by the applied field (AVa) and Josephson Vortex induced by microwave magnetic field (JVw). AVa is pinned by JVw at the higher Pm then the upper Solid phase boundary extends to higher field.

MA spectra were measured for Crossing field configuration ($H//45^\circ$). With increasing Pm, the Dip is extremely enhanced and Pb is shifted to higher fields. JVw decouples 2D pancake vortices then melting is promoted at the low field. While at the higher fields, AVa is pinned by the applied field-induced Josephson vortices (JVw), then the upper Solid-Liquid boundary is shifted up.