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Vortex Shaking by ac Transverse Magnetic Fields

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One efficient method to investigate the vortex matter in the high-temperature superconductors is to measure the magnetization while shaking vortices by applying a transverse ac magnetic field, H_{ac}. When a small transverse H_{ac} is superposed with the dc magnetic field, the vortices will experience time-varying torque by ac field. This vortex shaking gives rise to effective reduction of pinning energy, which in turn gives rise to a rapid relaxation of the irreversible magnetization. This experimental approach has been used to study the nature of the anomalous magnetization peak in a N_2-annealed Tl_2Ba_2CuO single crystal. A systematic reduction of dc magnetization was observed due to a dc electric field generated by ac transverse field, which leads to the decay of the magnetization. Furthermore, shaking vortex unveiled the otherwise unobserved anomalous magnetization peak; when H_{ac} =0, no noticeable structure in the magnetization loop was observed, but with vortex shaking by H_{ac} the magnetization loop deformed to exhibit the anomalous magnetization peak. The evolution of the anomalous peak with H_{ac} can provide a clue to the understanding of the underlying mechanism for the occurrence of the peak. We interpret the development of the second peak at finite H_{ac} due to more weakly-pinned three-dimensional vortices below the second magnetization peak macroscopically walking faster towards the relaxed state by H_{ac} than two-dimensional vortices at the peak region

keywords : ac transverse magnetic field, vortex shaking, anomalous magnetization peak