Oscillatory Dynamics of the Driven Vortex Solid in $YBa_2Cu_3O_{7-\delta}$ Single Crystals

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Abstract

Studies of dynamics of the driven vortex solid in clean detwinned $YBa_2Cu_3O_{7-\delta}$ single crystals have been carried out at temperatures and fields just below the thermodynamic melting line. It has been observed that "shaking" of the vortices with an alternating Lorentz force can crucially change their dynamics. Of particular interest was the strikingly unusual response obtained on applying an oscillatory drive current which was asymmetric, either in terms of its period or its amplitude. This response manifested itself as a very pronounced, low frequency (0.1-0.01 Hz) periodic variation of the voltage response amplitude. The period of these oscillations was independent of the applied current-modulation-frequency. We have found that the period of the oscillations corresponds approximately to the time which it would take for the whole vortex system to drift coherently across the width of the sample. We have proposed an interpretation of the oscillatory effects in terms of a defect superstructure that drifts across the sample with the same velocity as that of individual vortices. The stability of this superstructure has been demonstrated by various memory effects associated with the oscillatory response.