Signatures of strong pinning from current-voltage measurements

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The strong pinning theory describes vortex pinning in the regime of low density of strong defects and allows for quantitative treatment of vortex dynamics and creep. It yields a simple result [1] for the current-voltage (*I*-*V*) characteristic predicting a subcritical thermal creep region with exponentially suppressed voltage followed by an ohmic regime shifted by a temperature-dependent excess (critical) current. Here we analyse *I*-*V* measurements on $NbSe_2$ [2], InO [3] and MoGe [4] that exhibit the ohmic regimes at large drives characteristic for strong pinning and show that they are in excellent agreement with the theoretical predictions over a voltage range spanning several orders of magnitude. The density of defects as well as the field- and temperature dependence of the activation barrier are extracted directly from the fitting parameters. We further challenge the common perception of the activation barrier regarded as function of driving current and show that if barriers and creep effects persist beyond the critical current, it becomes more convenient to describe them through the Lorentz force lowered by the viscous force. This observation combined with some features of the experimental data leads to a proposal of an elegant phenomenological theory directly relating the vanishing of activation barrier upon approaching criticality to the current-voltage characteristic.

References

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