Metamagnetism, superconducting properties, and intrinsic vortex pinning in 1111 Fe arsenide single crystals probed by torque magnetometry

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Torque magnetometry in the $SmFeAsO_{1-x}F_x$ system, for $x = 0$ and 0.1, reveals a sharp and anisotropic metamagnetic transition which is clearly associated with the re-orientation of the Sm moments. Although the Neel temperature is $\sim$ 5 K, one needs fields in the order of 35 to 40 T to re-orient the associated moments, indicating very anisotropic exchange constants. The transport is affected by the transition, indicating a coupling between the FeAs and SmO layers. We also developed a method to separate the magnetic and the superconducting components which are superimposed onto the reversible component of the angular dependent torque $\tau_{rev}(\theta, H, T)$ in underdoped $LaFeAsO_{1-x}F_x$. By using the Kogan formalism we extract a strong $T-$ and $H-$ dependence for the superconducting anisotropy γ, and a power law dependence, for the penetration depth. At lower Ts, one observes the emergence of sharp peaks in $\tau_{rev}(\theta, H, T)$ for H oriented along an angle θ_c close to the superconducting planes and which are consistent with predictions for the intrinsic pinning of vortices by a layered crystallographic structure as well as a series of smaller structures at higher angles suggesting transitions among kinked vortex structures.