Magnetization Anomaly around Zero Field in the Superconducting State of Sr_2RuO_4

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In order to investigate the chiral-superconducting characteristics [1,2] as well as the vortex-pinning properties, detailed magnetization measurements of the single crystal Sr_2RuO_4 have been performed in the field parallel to the [001] direction, using a capacitive Faraday force magnetometer. The samples used are 3 single crystals in the clean limit. Anomalous pinning features are found at weak fields in the magnetization curves: Tiny flux-jumps successively appear around zero field at temperatures up to at least 0.2 K (Fig. 1(a)). At higher temperatures, a small peak of the hysteretic magnetization is observed below 0.1 kOe, which is so-called second magnetization peak (SMP), as shown in Fig. 1(b). The magnitude of the hysteretic magnetization is strongly dependent on (independent of) the field-gradient in the field region below (above) the field where the SMP appears. It should be noted that the peak structure becomes remarkable with increasing field-gradient: This indicates that the SMP-anomaly is not caused by the applied field-gradient because in such a case the peak should broaden with increasing field-gradient. Possible origins are discussed from the viewpoints of the pairing symmetry together with the topological change in the vortex-lattice configuration.

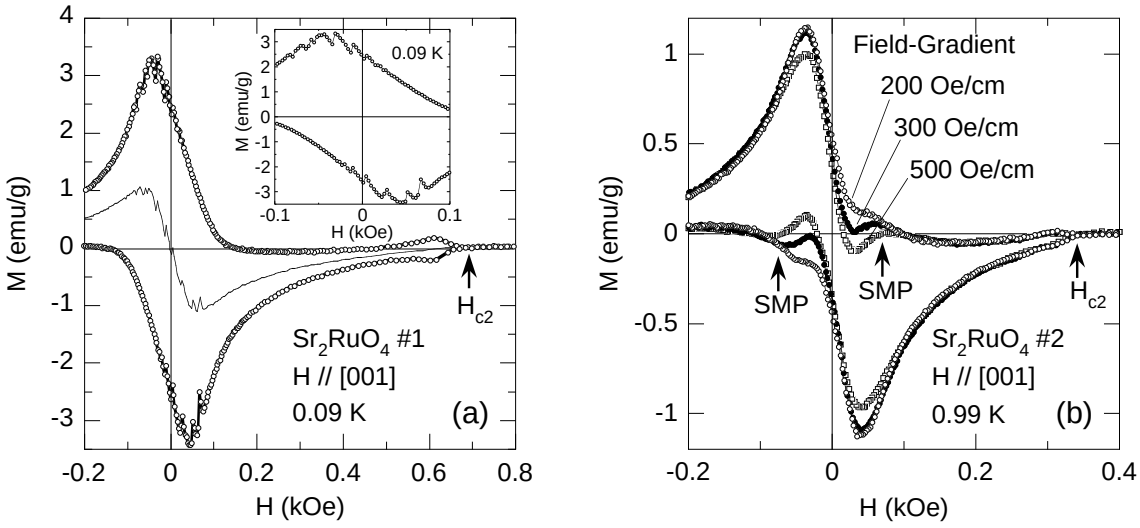

Fig. 1: (a) Isothermal magnetization curves of Sr_2RuO_4 at 0.09 K for $H \parallel [001]$. The thin solid line is the equilibrium magnetization curve. The inset shows successive and tiny flux-jumps of the magnetization around zero field. (b) Magnetization curves at 0.99 K under various field-gradients.

[1] G. M. Luke *et al*, Nature (London) **394** (1998) 558.
[2] K. Ishida *et al*, Nature (London) **396** (1998) 658.