Highlights

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Geometrical vortex lattice pinning and melting in YBaCuO submicron bridges

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We report on the geometrical melting of the vortex lattice in a wide YBCO submicron bridge preceded by magnetoresistance (MR) oscillations fingerprinting the underlying regular vortex structure. Combined MR measurements and numerical simulations unambiguously relate the resistance oscillations to the penetration of vortex rows with intermediate geometrical pinning and uncover the details of geometrical melting.
Our findings offer a reliable and reproducible pathway for controlling vortices in geometrically restricted nanodevices and introduce a novel technique of geometrical spectroscopy, inferring detailed information of the structure of the vortex system through a combined use of MR curves and large-scale simulations.

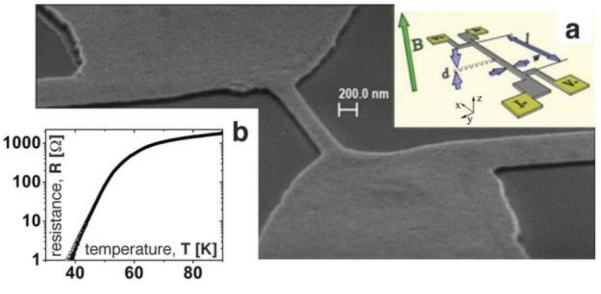

Figure 1. S.E.M. image of a 230 nm wide YBCO bridge. Inset a) shows the scheme of the magnetoresistance setup, inset (b) shows the log-linear plot of the bridge resistance in the temperature range (30–90) K.

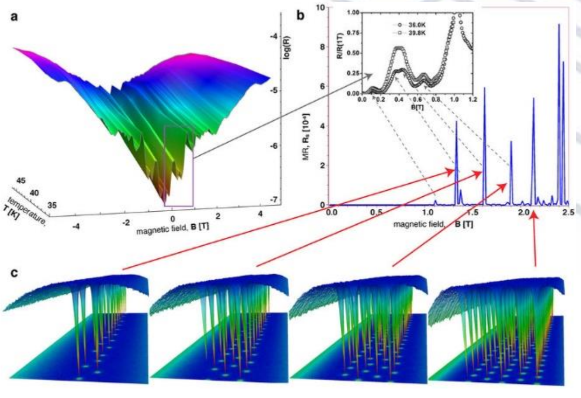

Figure 2. Magnetoresistance and vortex configurations. (a) Experimental MR of the 230 nm wide sample as a function of T. Important to note is that the position of the peaks does not change much with temperature. (b) Simulated MR of a 2D system with dimensions similar to those of the experimental system. The periodicity and the relative peak heights are reproduced correctly. The inset shows comparable experimental curves at 36 K and 39.8 K at low fields. (c) Vortex configurations at the peaks of the simulated MR curve.