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Imaging Vortices in $YBa_2Cu_4O_8$ using a Transmission Electron Microscope CHARLOTTE BOWELL, JAMES LOUDON, University of Cambridge, JANUSZ KARPINSKI, ETH Zurich, PAUL MIDGLEY, University of Cambridge — When magnetic flux penetrates a Type-II superconductor, it does so in the form of superconducting vortices. The study of these vortices can reveal information about the nature of the superconductivity in the material as well as being important for applications. These vortices can be imaged using a transmission electron microscope (TEM), as the electron beam is deflected by the penetrated magnetic flux. This technique was pioneered by Tonomura et al. [1], using a specially adapted microscope. Recently, it has been demonstrated that vortex imaging is also possible on a commercial TEM [2]. Here we present results on the cuprate superconductor $YBa_2Cu_4O_8$, in which CuO chains running along the crystal b-direction are thought to become superconducting via a proximity effect with the CuO_2 planes. A difficulty encountered with the TEM technique is in producing samples thin enough to be electron transparent. A sample, of size 30 μm x 30 μm x 200 nm, was cut from a bulk $YBa_2Cu_4O_8$ single crystal using focussed ion beam milling. To look into the influence of the CuO chains, Lorentz imaging was used to investigate the vortex configuration and movement in real time, while holography was employed to study the vortex field profile. [1] Harada et al., Nature 360, 51 - 53 (1992) [2] J. C. Loudon and P. A. Midgley, Ultramicroscopy 109: 700-729 (2009)

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