Electron holography of chondrule dusty olivine

J. Shah[1,2,] A. R. Muxworthy[1] , T. P. Almeida[1] , A. Kovács[3] , S. S. Russell[2] , M. J. Genge[1] , R. E. Dunin-Borkowski[3]
[1] Department of Earth Science and Engineering, Imperial College London, UK.
[2] Department of Earth Sciences, Natural History Museum, London, UK.
[3] Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons and Peter Grünberg Institute, Forschungszentrum Jülich, D-52425 Jülich, Germany
E-mail: jay.shah@imperial.ac.uk

Dusty olivine grains found within unequilibrated chondrites have the potential to have recorded early Solar System magnetic fields [1]. Understanding of the magnetic fields present during this period is crucial to models of the protoplanetary disk [2]. Estimates of the palaeomagnetic field from dusty olivine suggest magnetic fields played an important role in turning the protoplanetary disk into a planetary system [3]. Off-axis electron holography is a transmission electron microscopy technique that can be used to generate a magnetic induction map of the sample at the nanoscale [4]. Using electron holography, synthetic dusty olivine has proven to be a credible recorder of palaeomagnetic fields [5]. A recent study demonstrates that vortex state magnetite is capable of recording reliable thermoremanent magnetization [6]. Dusty olivine was prepared for TEM analysis by focused ion beam milling lamellae from a polished section of Bishunpur (BM 80339) onto DENS Solutions heating chips. We find highly magnetic, non-interacting vortex structures within the chondrule dusty olivine Fe metal. By heating the lamella in-situ up to 800°C and cooling back to room temperature, we present observations of the remanent magnetisation of dusty olivine up to the Curie point to investigate its nanoscale thermoremanent stability and credibility as a palaeomagnetic recorder.

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