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Individual Mammalian Cell Magnetic Measurements with a Superconducting Quantum Interference Device JOHANNA C. PALMSTROM, Gabilan Stanford Graduate Fellow, Geballe Laboratory for Advanced Materials, Stanford University, KIMBERLY BREWER, SUI SENG TEE, Department of Radiology, Stanford University School of Medicine, ERIC THEIS, Geballe Laboratory for Advanced Materials, Stanford University, BRIAN RUTT, Department of Radiology, Stanford University School of Medicine, KATHRYN A. MOLER, Geballe Laboratory for Advanced Materials, Stanford University — Magnetism can be introduced into otherwise nonmagnetic cells by the uptake of superparamagnetic iron oxide (SPIO) nanoparticles. SPIO nanoparticles are used in numerous biomedical applications including cellular therapies and targeted drug delivery. Currently there are few tools capable of characterizing individual magnetic nanoparticles and the magnetic properties of individual mammalian cells loaded with SPIO. Our scanning superconducting quantum interference devices (SQUIDs) are good candidates for these measurements due to their high sensitivity to magnetic dipole moments (approx. 200 $\mu_{\mathrm{b}}/\sqrt{\mathrm{Hz}}$) In this study, we use a scanning SQUID to image the magnetic flux from SPIO loaded H1299 lung cancer cells. We find that the magnetic moment spatially varies inside the cell with each cell having a unique distribution of moments. We also correlate these magnetic images with optical and scanning electron microscope images. These results show that the SQUID is a useful tool for imaging biological magnetism. The visualization of single cell magnetism and the quantification of magnetic dipole moments in magnetically labeled cells can be used to optimize conventional biological magnetic imaging techniques, such as MRI.

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