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Simultaneous three-dimensional imaging and manipulation of grain boundaries in colloidal crystals KAZEM V. EDMOND, YANYAN LIU, ARRAN CURRAN, DIRK G.A.L. AARTS, University of Oxford, STEFANO SACANNA, New York University, ROEL P.A. DULLENS, University of Oxford — Characterizing the properties of grains and grain boundaries is critical for understanding and controlling material properties. We investigate the dynamics of grain boundaries in crystalline materials using concentrated colloidal suspensions of microspheres. The micron-sized particles are suspended in a mixture of solvents whose refractive index and density nearly match those of the particles, enabling three-dimensional visualization and negating gravitational effects. Throughout the sample we disperse specially designed core-shell particles whose cores have a higher refractive index that can be optically trapped. Via optical tweezing, these core-shell particles enable us to directly interact with and probe grain boundaries in 3D within the colloidal crystal. We use a uniquely developed optical microscopy system that combines confocal imaging with holographic trapping, enabling quantitative imaging and precise manipulation simultaneously in three dimensions[1]. Our experiments provide direct insight into the properties of grain boundaries in crystals.

[1]A. Curran, S. Tuohy, D. G. A. L. Aarts, M. J. Booth, T. Wilson, and R. P. A. Dullens, "Decoupled and simultaneous 3D imaging and optical manipulation through a single objective" *Optica* **1**, 223 (2014)

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