Nice ‘n’ Easy: Making the Perfect Crystal

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Metal is an indispensable resource in our modern world with applications from towering skyscrapers to nanofabricated silicon devices. Understanding and exploiting properties of metals is the key to technological innovation. On the atomic level, metals exhibit a crystalline structure, which is not easily studied because of the microscopic size and fast time scale in which interactions take place. Colloids, or solid particles suspended in liquid, can be directed to settle under gravity into a crystal by patterning the surface upon which they fall. The resulting crystals closely mimic the atomic arrangements in metals and serve as a more easily studied slow-moving, macroscopic analog of these materials. An important feature of metals and their colloidal counterparts is the grain boundary, a place at which two regions of differently oriented crystals meet (see fig. 1). Along the boundary, various phenomena such as increased defect mobility are seen. The research objective is to grow the most perfect crystal and grain boundary as possible, so that future work can be carried out on dynamics around the grain boundary. We found that reducing the concentration of particles, which slowed the sedimentation process, formed crystals with fewer defects and better overall structure. Also of paramount importance is the quality of the template. Ultimately, new materials with novel characteristics could result.

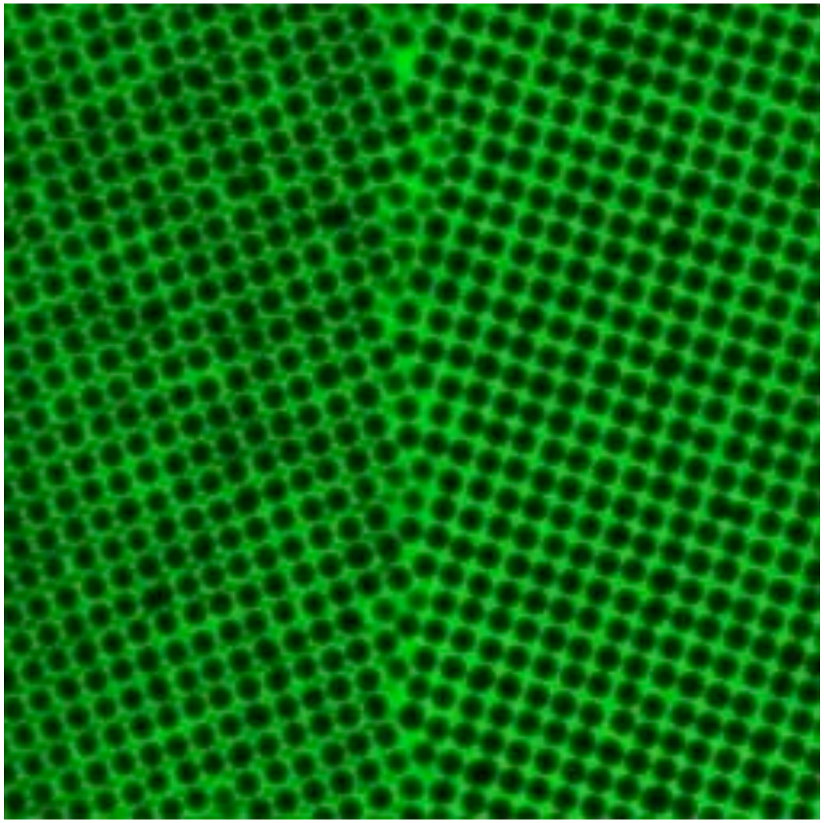

Fig. 1- Image of a Σ5 grain boundary in a cubic crystal taken with the confocal microscope. Black spheres are 1.5 μm silica particles. Note the spacing along the line dividing the two regions of crystal, which allows for more defect mobility in the crystal.

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