

structures, but also to arbitrary shapes. Currently, Zhang and colleagues are developing fully parallel arbitrary patterning plasmonic lithography.

ALFRED A. ZINN

Defects in Solar-Cell Materials Enhance Efficiency

Scientists working to improve solar cells have traditionally sought to eliminate defects found in their materials. However, it has been known for some time that polycrystalline solar cells with grain-boundary defects can be more efficient than their single-crystal counterparts. I. Visoly-Fisher, D. Cahen, and S. Cohen of the Weizmann Institute in Israel and A. Ruzin of Tel Aviv University have recently used a number of scanning probe techniques to determine how grain-boundary defects improve the performance of one type of polycrystalline solar cell. As reported in the June issue of *Advanced Materials* (p. 879), the researchers characterized the electrical properties of single grain boundaries and grain surfaces of $\sim 1 \mu\text{m}$ CdTe grains in $p\text{-CdTe}/n\text{-CdS}$ polycrystalline thin-film solar cells. The tools used included scanning capacitance microscopy, scanning Kelvin probe microscopy, atomic force microscopy (AFM), and conductive probe AFM.

Most commercial solar cells are made of single-crystal semiconductors such as silicon, but single crystals are expensive to manufacture. The more cost-effective solar cells made of polycrystalline films were found to outperform their single-crystal counterpart cells, which was an unexpected outcome. When light strikes the solar cell, the semiconductor within it serves as an antenna, absorbing the light energy and allowing the free flow of electrons

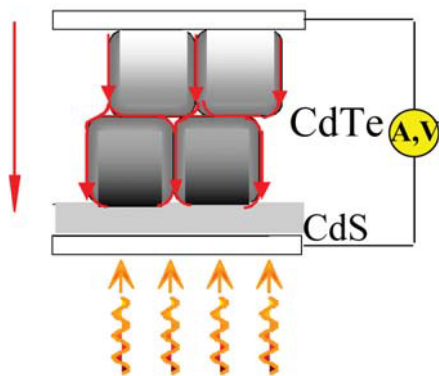


Figure 1. Grain boundaries within solar-cell films can improve the light-to-electricity conversion because they provide a path along which free electrons are efficiently collected and channeled.

present in the semiconductor. These electrons are then harvested as an electric current for external use. The researchers at Weizmann Institute demonstrated that grain boundaries within CdTe/CdS polycrystalline solar cells improve the light-to-electricity conversion because they provide a path along which the free electrons are efficiently collected and channeled on their way out (see Figure 1). The researchers indicated that the efficient collection of electrons is due to the beneficial effects of the CdCl₂ vapor treatment that occurs during processing of these cells. The treatment getters both defects and impurities along the grain boundaries and alters the doping profile to facilitate spatial separation of electrons and holes, thus reducing recombination.

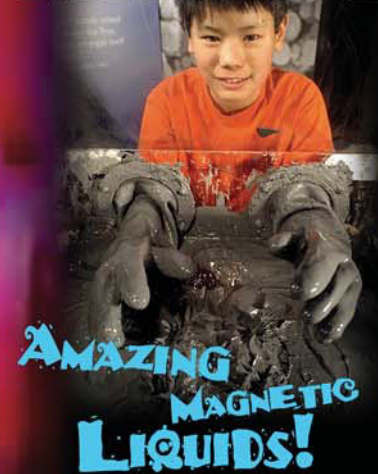
Large-Scale Synthesis of Nearly Monodisperse Au and Ag Nanoparticles Achieved

Gold and silver nanoparticles are important in diverse areas ranging from fundamental research to applications in electronics (single-electron transistors), catalysis, chemical sensors, and biosensors. These applications require nanoparticles in the 2–100 nm range that are surface-derivatized with hydrophobic and hydrophilic surfactants. H. Hiramatsu and F.E. Osterloh of the University of California, Davis, have demonstrated an inexpensive, versatile, and reproducible method for the large-scale synthesis of organoamine-protected gold and silver nanoparticles in the 6–21 nm (Au) and 8–32 nm (Ag) range and with polydispersities as low as 6.9%.

Usually such nanoparticles have been fabricated by either the citrate method or the two-phase (Brust) method. The citrate method produces nearly monodispersed gold nanoparticles in the size range of 2–100 nm; however, the resulting solutions have a low nanoparticle content, and the solvent choice is restricted to water. Moreover, the resulting nanoparticles cannot be surface-derivatized with hydrophobic surfactants. The two-phase method, on the other hand, allows the introduction of hydrophobic thiols as surfactants, but it suffers from the limitation to small particle sizes (<10 nm), greater polydispersity, and higher costs for the phase transfer agents.

The synthesis described by Hiramatsu and Osterloh in the June 29 issue of *Chemistry of Materials* (p. 2509) requires only three reagents, namely, tetrachloroauric acid or silver acetate, oleylamine, and a solvent. The particles are stable in solid form and can be easily modified with hydrophobic and hydrophilic thiols to

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