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Silver sulfide nanoparticles show promise as fluorescent probes for imaging deep tissue injuries due to their emission in the near-infrared region of the electromagnetic spectrum and low biological toxicity. However, a common problem among many nanoparticles, including silver sulfide, is that the individual nanoparticles tend to cluster together and aggregate into larger structures. To examine both the fluorescence properties of silver sulfide nanoparticles and their assembly into larger structures, we first synthesized colloidal silver sulfide nanoparticles of different sizes using dodecanethiol as a capping ligand. The resulting nanoparticles were washed with isopropanol to remove excess dodecanethiol and then stored under different atmospheric environments. Nanoparticles stored in an argon environment were observed to assemble into highly ordered structures (supercrystals), while nanoparticles stored in an oxygen-rich environment remained as individual particles around 5-6 nm in diameter. Using X-ray photoelectron spectroscopy, it appeared that the assembly of silver sulfide could be prevented by the surface oxidation of the nanoparticles. This could explain why supercrystals were not observed when the nanoparticles were stored in an oxygen-rich environment. Electron microscopy was used to show that the supercrystals possessed well-defined morphologies that resembled either "octahedrons" or "stars". We are currently testing what factors affect the final morphology of these supercrystals such as reaction temperature, reaction time, and ligand concentration. Scanning electron microscopy was used in conjunction with different chemical analysis techniques (infrared spectroscopy, raman spectroscopy, nuclear magnetic resonance) to identify a strong correlation between the quantity of surface ligands and the supercrystal morphology.