

Controllable Synthesis of Cu_2S Nanocrystals and Their Assembly into a Superlattice

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Introduction

Cu₂S nanoparticles are interesting area of science in nanoscience and technology since it is a p-type semiconductor with band gap of 1.2 eV.

**It has verity of potential application in various areas
Such as**

Solar cells

Cold cathodes

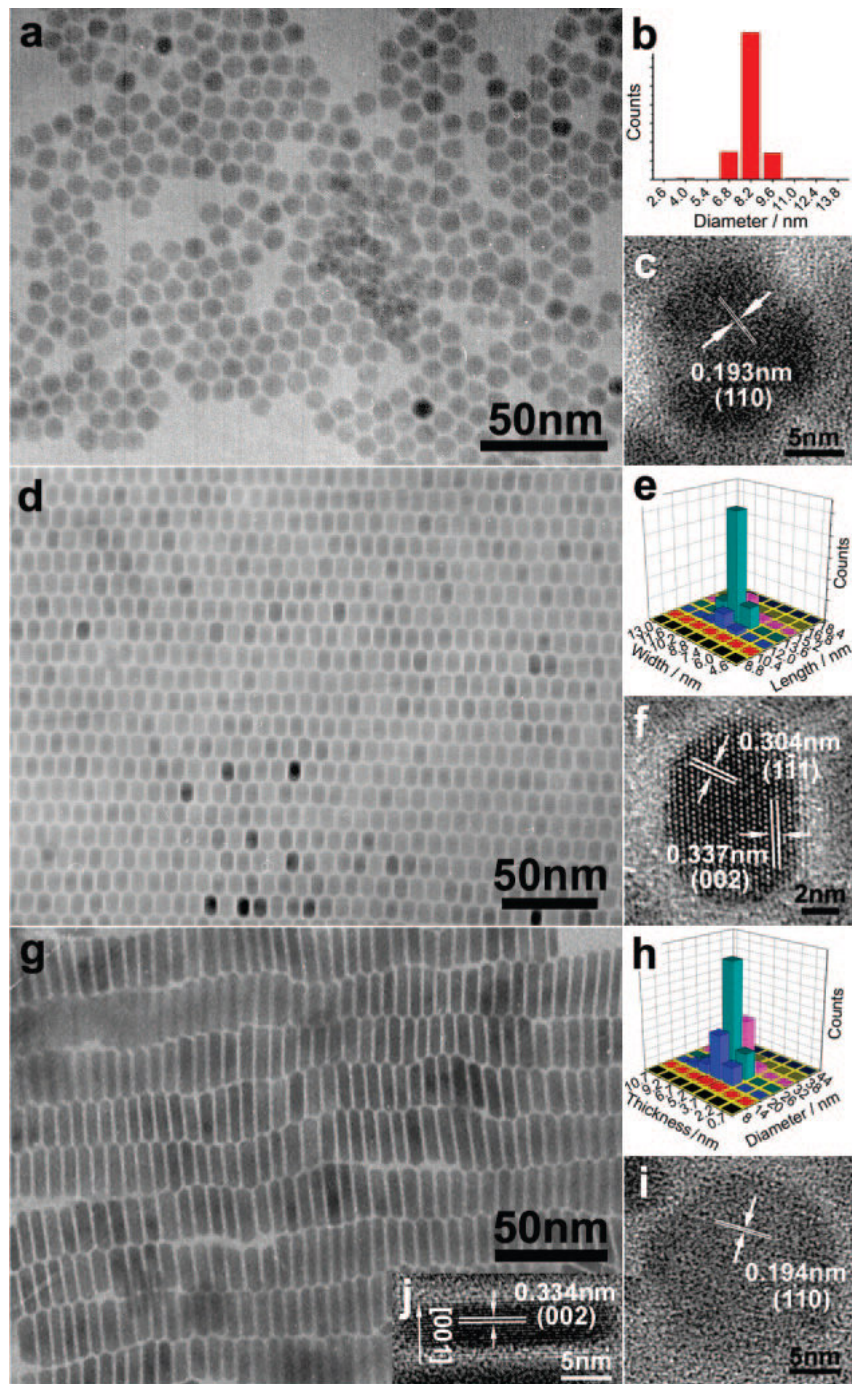
Nanoscale switches

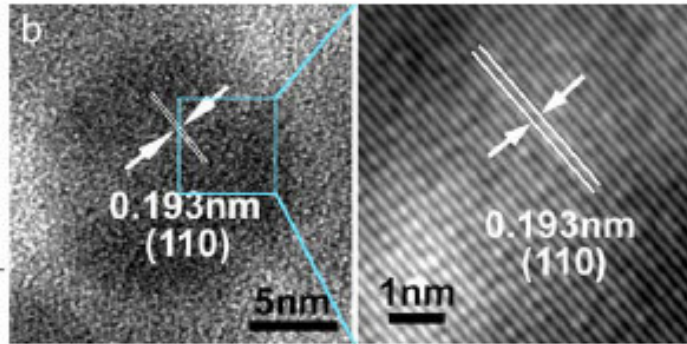
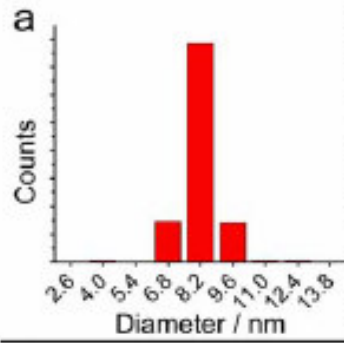
Cu₂S nanoparticles

In a typical synthesis of 8.2 nm diameter Cu₂S circular nanocrystals, Cu(NO₃)₂·3H₂O (0.24 g, 0.001 M) was dissolved in deionized water (20 ml) to form a clear blue solution. Then sodium acetate (0.82 g, 0.010M) and acetic acid (0.60 ml) were also introduced into the solution. After keeping stirring for 15 min, the solution was transferred into a Teflon-lined autoclave of 40 ml capacity and dodecanethiol (3 ml) was added finally into the solution. The autoclave was sealed and heated at 200 °C for 6 h. After the autoclave was cooled to room temperature, the product was collected and the water in the autoclave was discarded. Then 20 ml ethanol was introduced and the product was washed and precipitated. The mixture was centrifuged for 5 min at 4800 rpm, and the precipitate was collected.

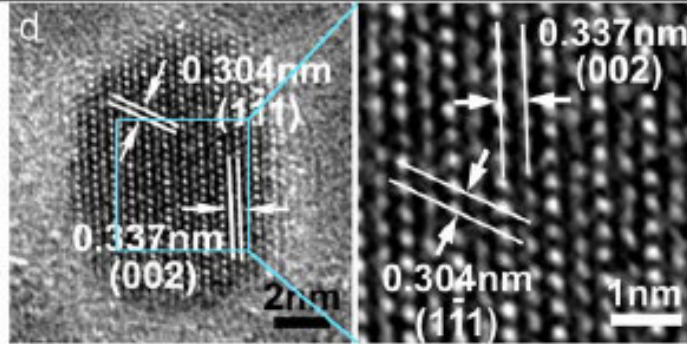
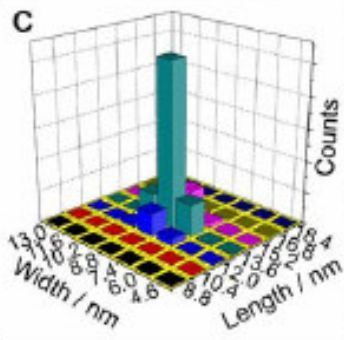
For hexagonal Cu₂S nanoplates, KCl (1.0 g) was introduced into the Cu(NO₃)₂ solution, without sodium acetate and acetic acid.

For elongated nanocrystals, only 0.12g Cu(NO₃)₂·3H₂O was dissolved in deionized water (20ml) and neither sodium acetate nor KCl was added. After keeping stirring for 15 min, the solution was transferred into a Teflon-lined autoclave of 40 ml capacity. Then toluene (5 ml) and dodecanethiol (0.5 ml) were added into the solution. Finally, the autoclave was sealed and heated at 200 °C for 20 h. After the autoclave was cooled to room temperature, the product was treatment as previously described.

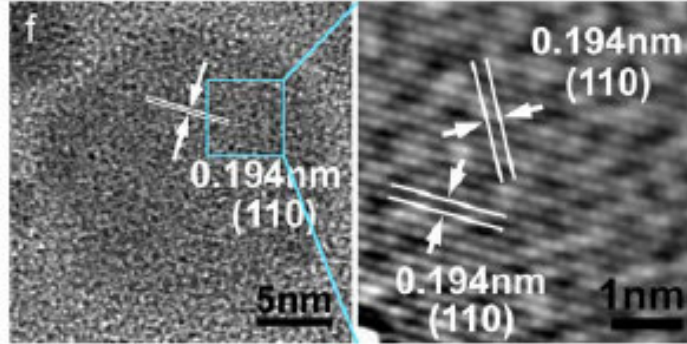
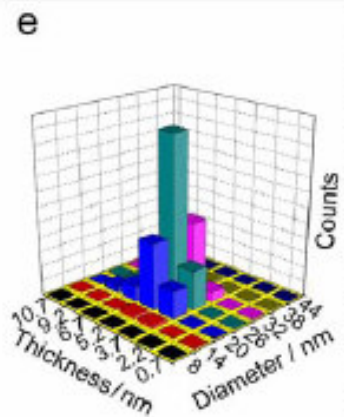




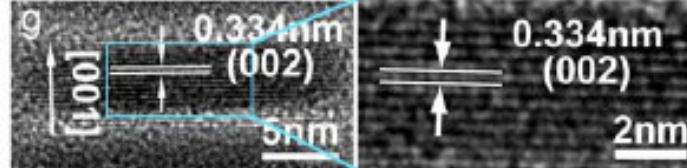
8.2 nm

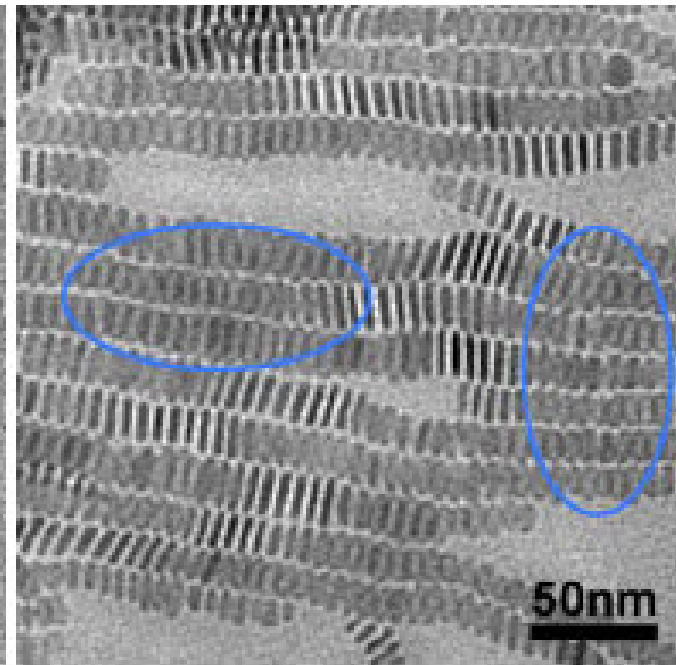
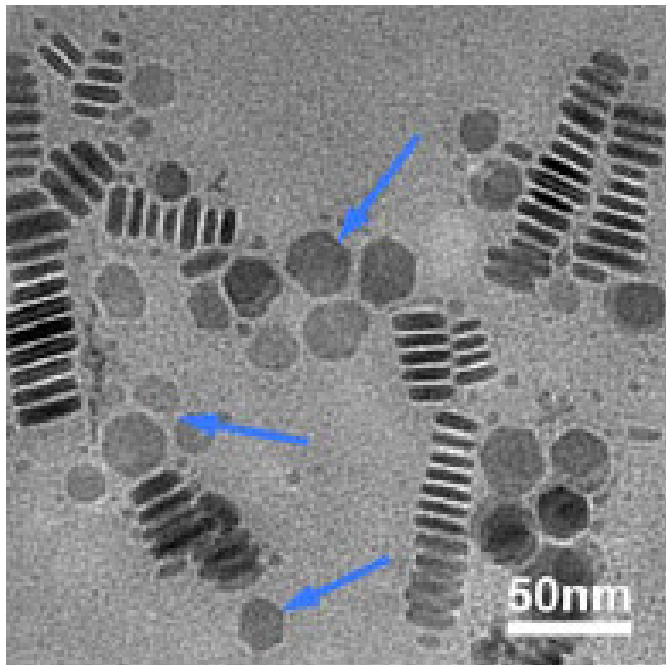


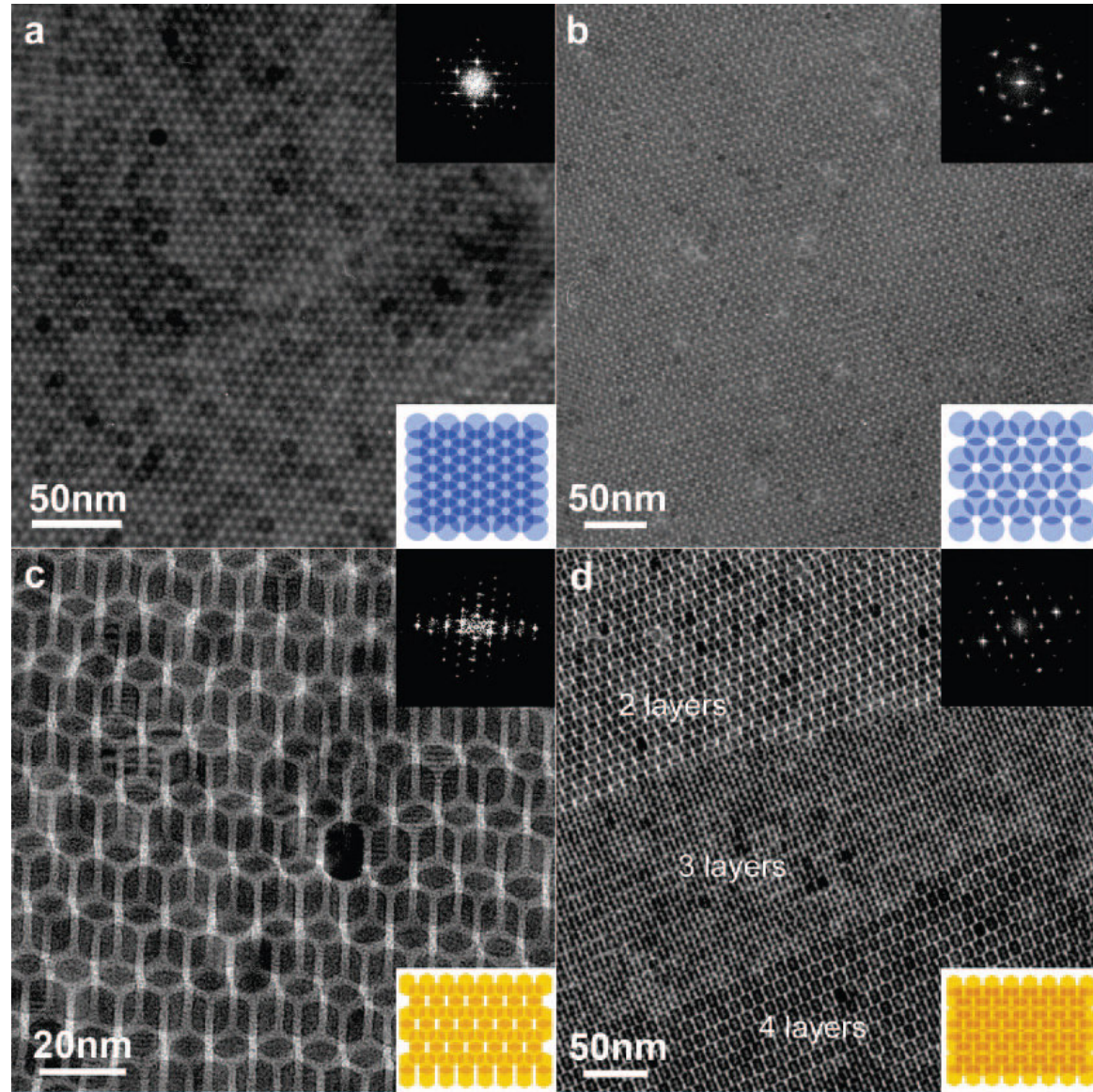
13.6/8.8

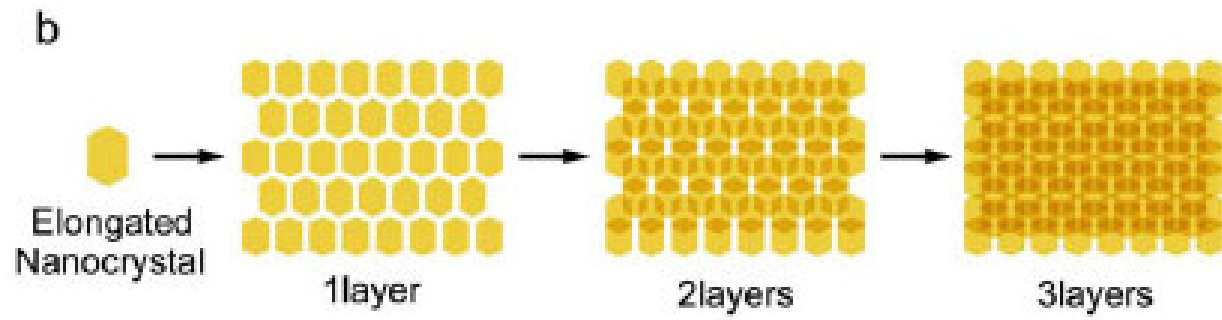
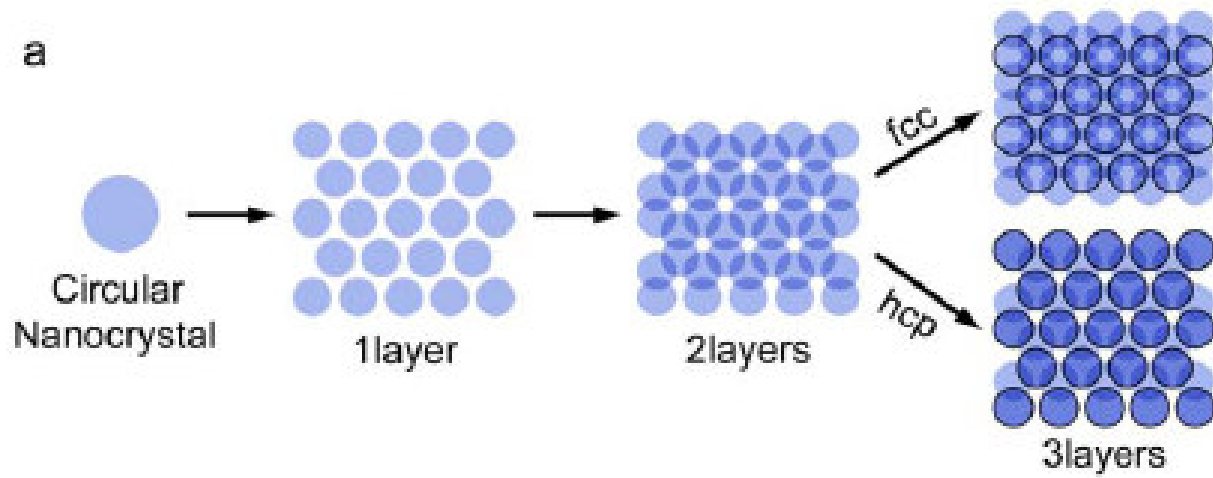


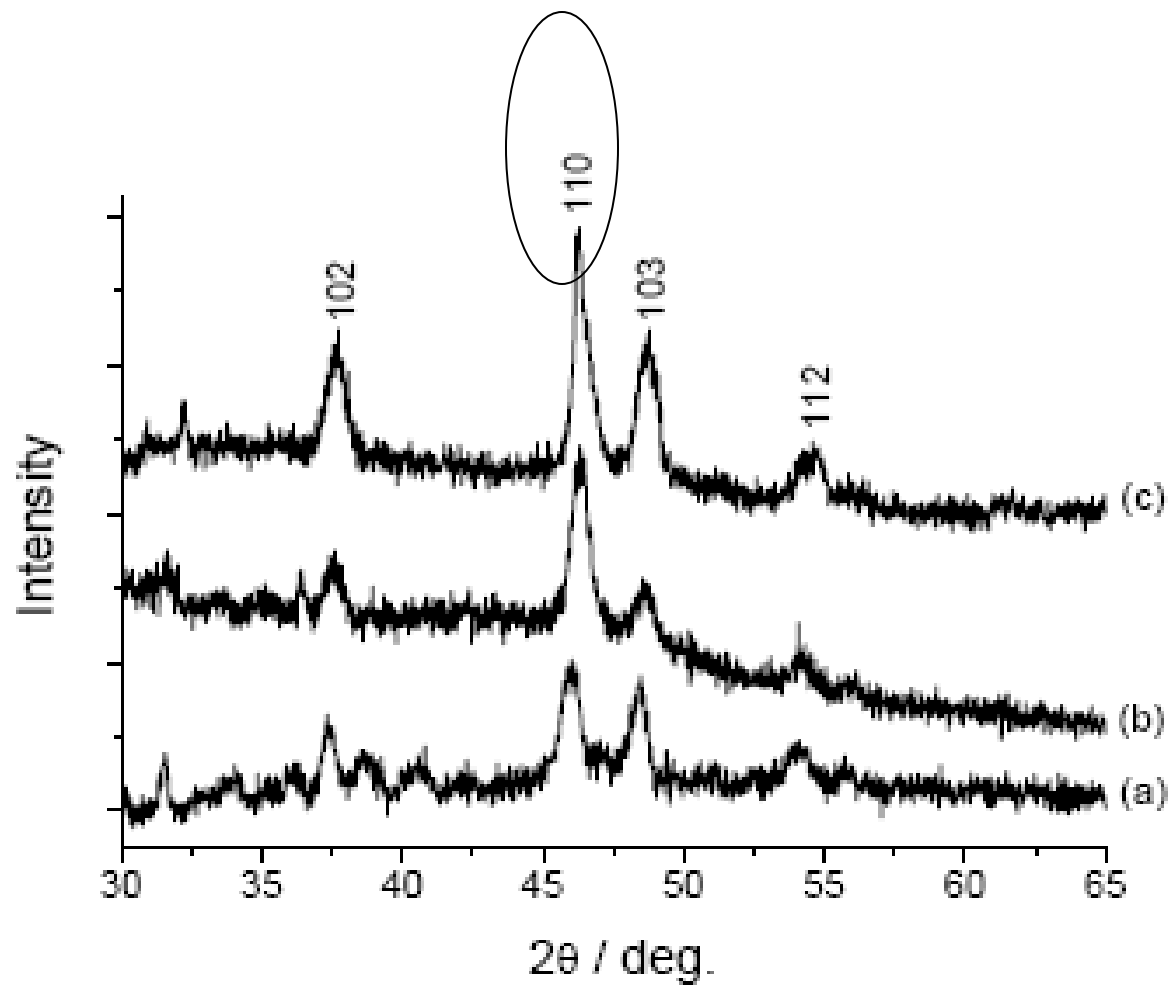
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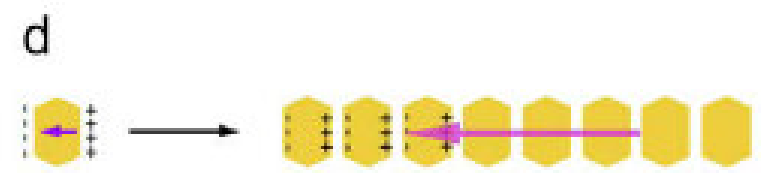
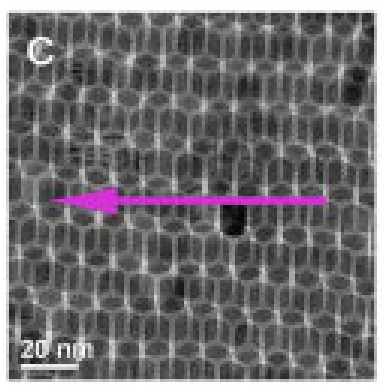
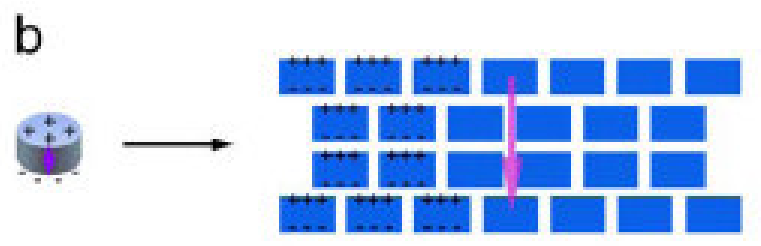
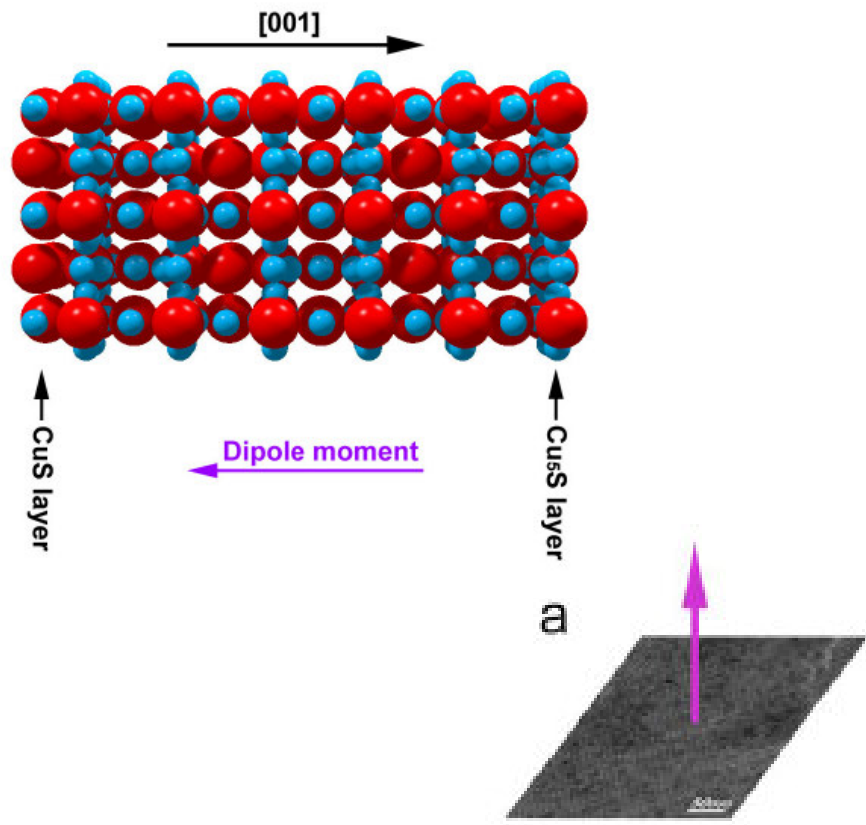




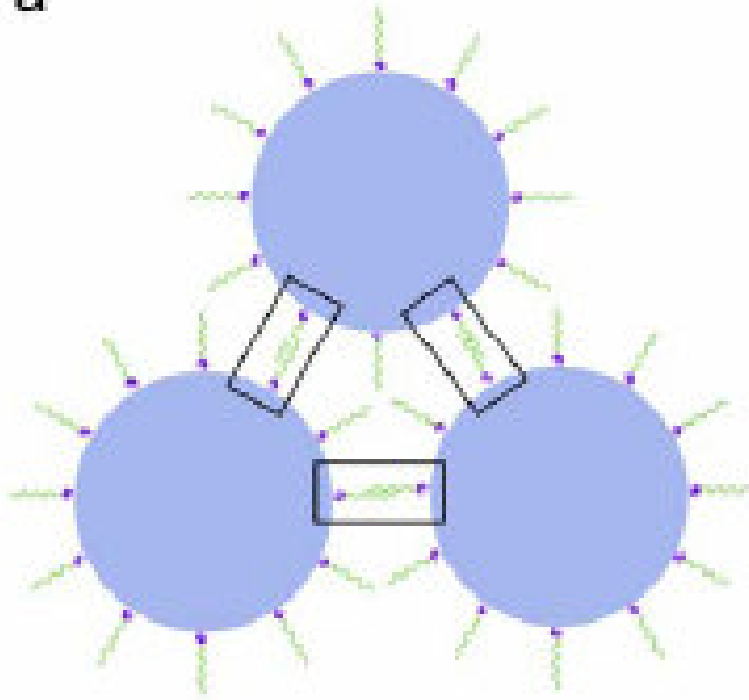




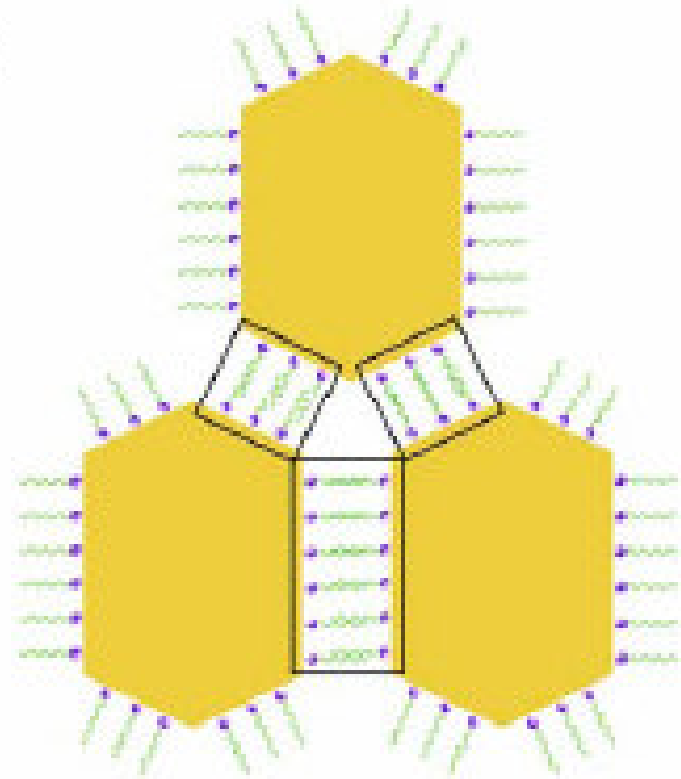


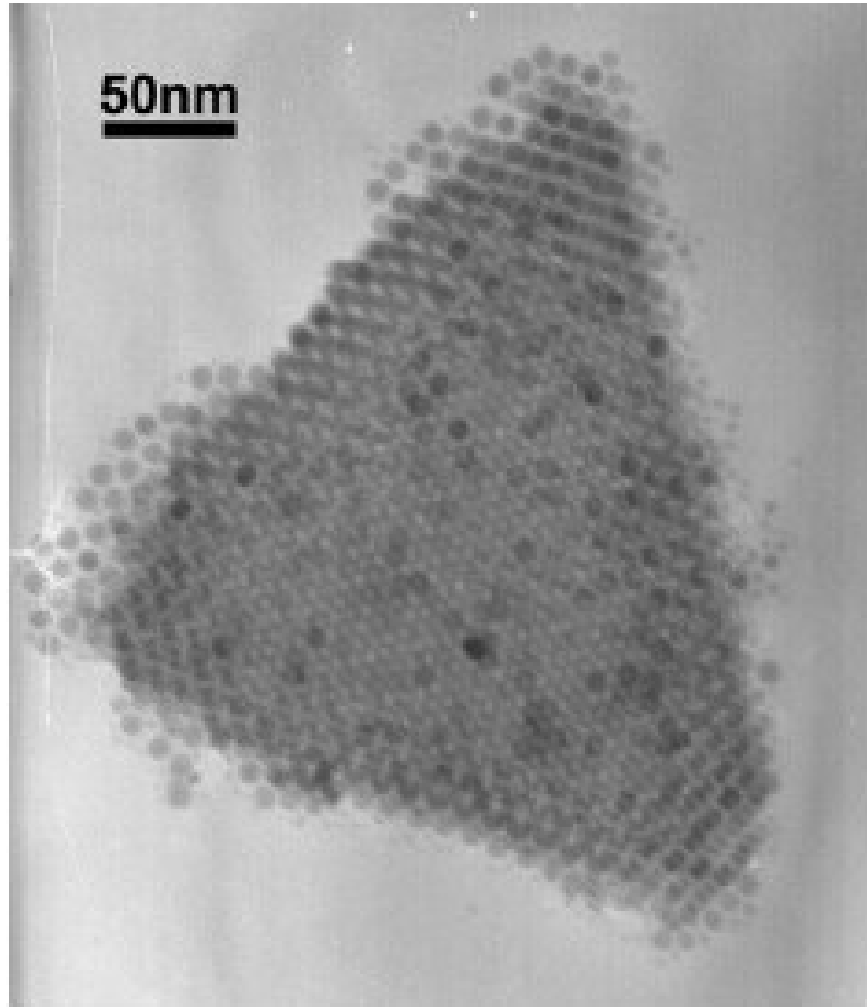


a



b





Summary

1. Synthesized highly uniform Cu_2S nanocrystals at oil-water interface.
2. Different morphologies were observed by changing the reagents.
3. Synthesized the 3-D superlattices by controlling the morphologies.
4. 3-D arrangement of spherical and elongated nanoparticles were explained using the dipole moment factor.
5. They can be used for the potential applications in nanodevices.