

**Graphene encapsulated nanoparticles:
Growth, Characterization and Raman Studies**

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Gold nanoparticles were synthesized in both single-step and seed-growth step for systematic study of shape and size control. The effect of growth factors was evaluated by varying single parameter (temperature, metal salt concentration, surfactant type or concentration, seed amount, or growth duration) once at a time, while other parameters were kept constant. The size, shape, crystallinity, and sample heterogeneity for the nanoparticles were characterized by transmission electron microscopy. As a next step, gold nanoparticles were plasma oxidized to result in surface oxidized nanoparticles, which is important for the third step of graphene shell growth. X-ray photoelectron spectroscopy was used to characterize oxidized gold and graphene shell. The quality of graphene shell was characterized by Raman spectroscopy.