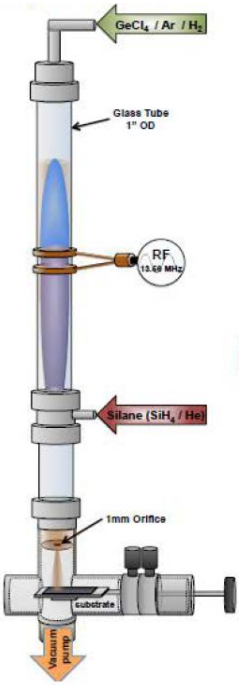

Nonthermal Plasma Synthesis of Core/Shell Nanocrystals

Semiconducting nanocrystals have drawn increasing interest over the last few decades, and developing methods for epitaxial shell growth in solution is a key advancement. Despite the technological importance of bulk group IV semiconductors (Si, Ge), development of core/shell nanocrystals using these materials has lagged. In recent years, using nonthermal plasmas to synthesize group-IV nanocrystals has offered significant advantages over other approaches, but their colloidal stability has rendered plasma-synthesized group IV nanocrystals incompatible with common solution-phase shell growth approaches. With a variety of potential uses, such as biological imaging, photovoltaic cells and energy storage, increasing production yields of epitaxial core shell particles reduces costs and expands the market for this technology.

Description of the Invention

An innovative gas-phase method uses a modified plasma reactor to generate core/shell nanocrystals in nonthermal plasmas by afterglow PECVD shell growth. The technology uses afterglow to react a secondary shell onto a primary (core) particle to synthesize group IV nanocrystals that could be used in a variety of applications. Using afterglow limits nanoparticle temperature, which may suppress interdiffusion at the core/shell interface and reduce the degree of alloying. This process, which generates minimal chemical waste, reduces particle agglomeration and does not use any additional ligands, produces epitaxial particles with improved photonic properties and allows for deliberate doping of the nanocrystal core and/or shell.

Features and Benefits

- Synthesizes group IV core/shell nanocrystals
- Minimal chemical waste
- Reduced particle agglomeration
- Does not use any additional ligands
- Produces epitaxial particles with improved photonic properties
- Reduces energy loss created when particles shift incident light into a separate part of the spectrum
- Allows for deliberate doping of the nanocrystal core and/or shell

Potential Applications

- Biological imaging
- Energy storage/conversion
- May apply to any material synthesized via nonthermal plasma (e.g., doped Si, SiGe, ZnO, GaN, etc.)
- Photovoltaic cells (solar cells)

Technology Status

Working prototype.

Publications

10.1021/acsami.6b16170

IP Status

Patent Pending

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