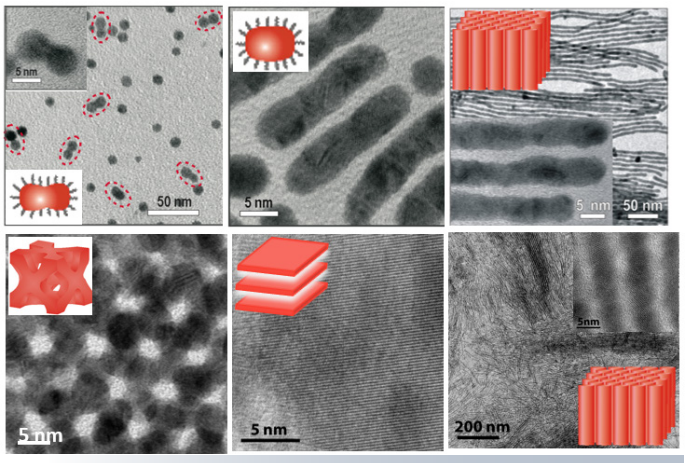
PRESSURE-INDUCED FABRICATION OF NANOMATERIALS

US Patents 8,455,048; 9,180,420; and 9,187,646
SD# 11478, 12473
Technology Readiness Level (TRL): 3-4
Key elements demonstrated in Laboratory environments

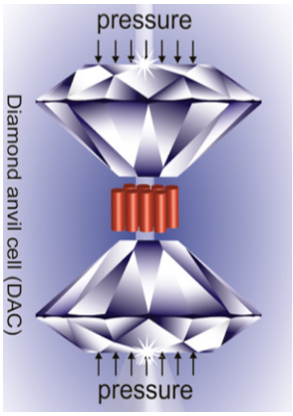
A simple, efficient approach that uses mechanical pressure to tune and fabricate novel nanomaterial architectures with breakthrough properties

Nanomaterials possess shape and size-dependent properties for diverse applications such as sensing, optics, and catalysis. Currently, nanomaterials are synthesized using chemical methods that require specialized processing conditions, expensive reactors and requirements, added purification steps, and highly trained operators. Simplified nanoparticle synthesis presents opportunities to reduce production cost, improve quality and structure, and minimize the environmental and safety concerns related to current state of the art.



SEM imagery shows pressure-induced fabrication of functionally designed nanomaterials.

Sandia researchers have developed a simple, efficient approach that uses mechanical pressure to tune and fabricate novel nanomaterial architectures with breakthrough chemical and physical properties. The application of external pressure eliminates the need for specific chemical and physical interaction and provides a streamlined process. Pressure can be applied using a diamond anvil cell, piston-cylinder device, multi-anvil cell, or embossing machine. Gradual elevation of pressure can be applied below a threshold (8 GPa) to reversibly tune the interparticle spacing of ordered assemblies of metallic nanoparticles. When the applied stress exceeds the threshold pressure, the nanoparticle assemblies begin to contact, coalesce, and finally weld to form new nanostructures, such as nanorods, nanowires, and nanosheets.



A diamond anvil cell (DAC) is used to apply mechanical pressure to a nanoparticle film.

TECHNICAL BENEFITS

- Produces finer and cleaner results
- Compatible with II-VI or IV-VI semiconductor materials
- Can be used to refine metals and semiconductor materials
- Eliminates environmentally harmful processes and residues

INDUSTRIES & APPLICATIONS

- Photocatalysts and phototherapy solutions
- Semiconductor fabrication
- Optical devices
- Nanomaterial fabrication
- Nanosensors

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SAND2021-2157 M