Stress-Induced Nanofabrication

US Patent: 8,455,048

TRL Level: 6

System/subsystem model or prototype demonstration in a relevant environment. Representative of the deliverable demonstrated in relevant environment.

Technology Summary

Sandia National Laboratories has developed a method for making nanomaterials by applying pressure to three dimensional nanoparticle assemblies, transforming them into compact, two dimensional structures. Nanomaterials are in high demand, as they contain properties particular to their size and structure that are integral to the development of metamaterials. Metamaterials are solids that have properties not found in nature, and they offer innovative applications in nanoelectronics and nanophotonics.

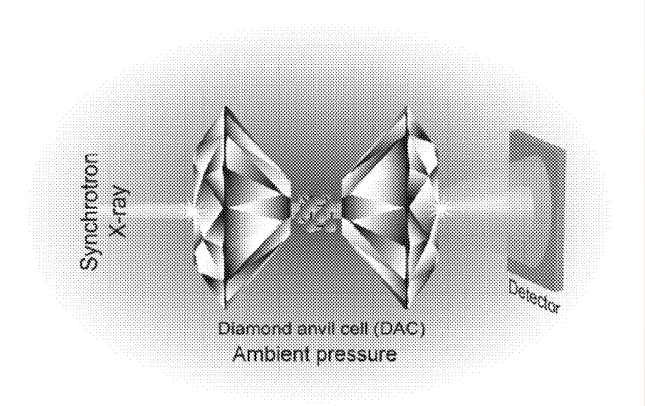

Illustration of a nanoparticle film loaded into a diamond anvil cell

Currently, the synthesis of nanomaterials relies on special interparticle chemical and physical reactions, which restricts their development. However, stress-induced nanofabrication can effectively render arrays of nanomaterials uniform in length, diameter and density. This method applies two forms of pressure– hydrostatic and non-hydrostatic– on a metal film to create nanomaterial architectures without relying on these special reactions. Furthermore, when pressure is applied past a certain threshold, the nanoparticles are forced to compact, creating a new class of chemically stable structures that cannot be formed using current methodology. The amount of stress can be manipulated to produce the desired structure of the subsequent nanomaterial, whether that is a nanorod, nanowire, or a nanosheet. The ability to control the structure of a nanomaterial and its response to high pressure has greatly added to the knowledge of nanomaterials. This method of nanomaterial self assembly can open the doors to large scale fabrication and applications.

Potential Applications

- Nanostructure fabrication
- Semiconductor nanostructures
- Optic devices
- Nanoelectronics

Technological Benefits

- Requires simple pressure
- Produces finer and cleaner results
- Easily integrated into manufacturing lines without the need for expensive or specialized equipment
- Can be used to refine various metals
- Produces no environmentally harmful residues

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