

# Method for Solid State Crystal Growth

**R**esearchers at the University of South Florida have developed a novel method for high quality single crystal growth of technologically important intermetallic materials. These materials include clathrates that hold enormous potential for solving many of the material limitations of energy conversion applications.

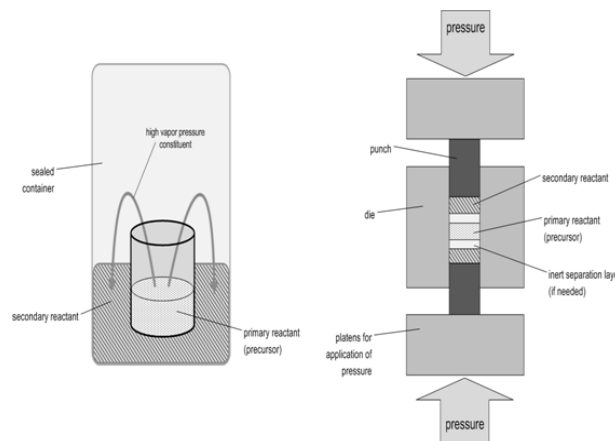
The commercial usefulness of many technologies is limited by the materials they utilize. Since improvements on existing materials are often not enough to provide significant advancements, new materials, structures, and/or approaches must be found. As an example, intermetallic clathrates are a novel class of materials currently being widely investigated for the potential they hold to impact and address a number of materials limited problems in energy conversion applications. The realization of the expected properties for these materials may revolutionize the commercial viability of important applications such as thermoelectric power generation and photovoltaic energy conversion. However, one of the substantial challenges to this realization lies in the preparation and crystal growth of high quality materials, which includes precise control over chemical composition, production of high quality crystalline product, and an inexpensive, reproducible, and safe method for manufacturing these materials.

To overcome the above challenges, our inventors have developed a novel industrially accessible method for crystal growth of intermetallic materials, which includes clathrates, as well as a number of other materials. Crystal growth of the desired product is facilitated by controlled alteration of the primary or precursor compounds, by achieving the necessary mass transport and constituent partial pressure conditions that are needed. A key specific advantage of the invention is the ability to grow the crystals in such a way that the individual materials of the crystals have greatly differing melting points and/or vapor pressures without any impurity phases.

### ADVANTAGES:

- High quality single crystal growth of intermetallic materials
- No impurity phases
- Inexpensive, reproducible, and safe
- Can be readily utilized in industries

### High Quality Crystal Growth of Intermetallic Materials



*Schematics of two apparatuses which facilitate the invention. The apparatuses are contained within an appropriate furnace chamber allowing temperature control and an appropriate atmosphere, including, but not limited to, high vacuum, inert gas (argon, nitrogen, etc.), or reducing atmosphere (partial H<sub>2</sub>, etc.).*