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Hydrothermal Growth of High Quality Rhombohedral Crystals (06-009, 05-027)

Low Temperature Growth of Harder and Higher Quality Rhombohedral Fluorberyllium Borate Crystals

Market Overview

This crystal growth approach utilizes hydrothermal growth to produce high quality, single crystals of sufficient size for use in ultraviolet solid state lasers. There is an increasing demand for higher performance materials that can be used in solid state lasers. The desired materials, however, must be high quality single crystals large enough and capable of being cut, shaped, and polished appropriately for use in solid-state optical lasers. Clemson University researchers have developed a general hydrothermal crystal growth process that produces crystals in a low temperature under pressure. Ultimately, this crystal manufacturing approach allows an economically feasible way to mass produce quality, acentric crystals that are suitable for deep, ultraviolet laser applications.

Application

Optics, Solid-state lasers; Crystal manufacturing

Stage of Development

Proof of Concept

Advantages

- Employs easily attainable hydrothermal growth techniques, creating commercially viable conditions for mass production of large crystals exhibiting fewer defects and less thermal strain
- RBBF crystals produced can be used to perform optical processes such as second harmonic generation, generating coherent radiation in the form of laser light, in the ultraviolet region
- Bypasses the limitations imposed by KBBF crystals, allowing for harder and higher quality RBBF crystals to be grown

Technical Summary

This invention showcases the use of hydrothermal crystal growth to produce rhombohedral fluoroberyllium borate crystals having the formula MBe2BO3F2 (MBBF) wherein M is Rb, Cs, or Tl. The crystal growth process is a low temperature method in which the crystals are being grown in an aqueous solution containing fluoride ions at a temperature generally within the range of 350oC-600° C under pressure. In this specific crystal growth process, the crystals are grown in the rhombohedral space group, R32. Clemson University researchers first used this approach to create rhombohedral potassium fluoroberyllium borate (KBBF) crystals. However, due to the limitations that arise from KBBF crystals, the inventors began to use Rb, Cs, and Tl metals versus potassium. As a result, this hydrothermal crystal growth approach allows for the mass production of much harder, higher quality crystals for optical laser applications.

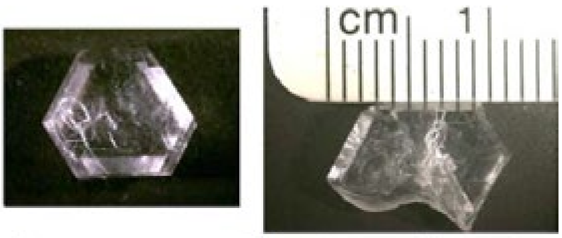

Figure 1: As-grown RBBF (left) and KBBF (right) crystals

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About the Inventor

Dr. Joseph Kolis is a Professor of Inorganic Chemistry at Clemson University, He earned his Ph.D. at Northwest University working in organometallic chemistry and conducted postdoctoral research at McMaster University. Dr. Kolis is a founding member of the Center for Optical Materials Science and Engineering Technologies (COMSET) at Clemson University where his group studies the synthesis and chemistry of novel inorganic compounds that demonstrate unusual structures and properties. He is the recipient of numerous awards, including the National Science Foundation Award for Special Creativity and the Alfred P. Sloan Fellowship and holds over seven patents.

For More Information

To learn more about this technology, please contact:
Andy Bluvas
Technology Commercialization Officer
bluvasa@clemson.edu
(864) 656-5157

Application Type	Country	Serial No.	Patent No.	CURF Reference No.	Inventor
Utility	United States	11/633,263 12/660,540 11/633,260 11/633,261	7,731,795 8,834,629 7,540,917 B2 7,591,896	06-009 05-027	Joseph Kolis, Colin McMillen