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Simplified Production of Single Crystals for Solid State Laser Applications (2013-060)

Cutting Trenches or Drilling Holes in the Substrate Seed Allows for Mass Hydrothermal Production of Single Crystals

Market Overview

This approach to growing heterogeneous single crystals relies on cutting trenches or drilling circular holes in the substrate seed and allowing hydrothermal growth of the crystals to occur. The resulting crystals can be used as the active medium in solid state laser applications. The global market for solid state lasers is projected to steadily increase, reaching $850 million by 2020. However, the market lacks a manageable and simplified method for mass production of single crystals which creates a problem for the increasing demand for solid state lasers and appropriate materials. Clemson University researchers have developed two specific approaches of hydrothermal growth that creates multifunctional layers of crystals from a trench carved into an appropriate substrate or by drilling holes of varying diameters in the substrate. The crystal growth processes are promising for simplified mass production, making it very advantageous to the optic industry.

Application

Optics; Solid state lasers

Stage of Development

Proof of concept; preliminary prototype

Advantages

- Can be openings of any shape or size, allowing hydrothermal growth of crystals in a wide variety of internal region formations
- Applies to any metal oxide host that can grow crystals via the hydrothermal method, producing a universal process that can be used on a variety of crystal material
- Enables a repeatable process for hydrothermal growth of single crystals, resulting in a simplified means of mass crystal production

Technical Summary

This method of hydrothermal growth produces single heterogeneous crystals by utilizing trenches and drilled holes within the substrate seed. Hydrothermal growth of crystals relies upon the use of hydrothermal fluid, a low viscosity fluid that can transport material to irregular surfaces and allow growth of crystals. By cutting trenches or drilling round holes in substrate seed and subjecting them to this hydrothermal growth process, trenches and circular holes with singles crystals are produced, creating a columnar region of laser gain medium. This growth process can repeated multiple times using various sized depressions, allowing for a simplified means of mass production of crystals that can be used in numerous laser and optics applications.

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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

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Application Type	Country	Serial No.	Patent No.	CURF Reference No.	Inventor
Provisional	United States	62/156,550	NA	2013-060	Joseph Kolis, Colin McMillen