Hydrothermal Growth of Single Crystals for Solid State Lasers (2017-002)

New crystal structure eliminates disorganized oxygen atoms for better optical performance

Market Overview

This crystal growth approach utilizes a hydrothermal process to produce single crystals for use in ultraviolet (UV) solid state lasers. The global market for industrial lasers is projected to grow from $4.6 billion in 2015 to $6.3 billion in 2020, reflecting a significant and growing commercial interest. Existing crystals for UV solid state lasers consistently perform poorly, whether its inefficiency or processing problems. Further, the current industry standard – a nonlinear optical crystal called SBBO – contains a disordered oxygen atom structure that inhibits the crystal's performance. To resolve this issue, Clemson University researchers have developed a new single crystal using hydrothermal growth. This approach creates single crystals that are different in structure and completely eliminate disordered oxygen atoms. The resulting crystals show excellent nonlinear properties for improved optical performance in UV solid state lasers.

Technical Summary

A new crystal, SBBO, was introduced some years ago that initially appeared to have improved properties. However the material did not receive much study because its structure contained badly disordered oxygen atoms. This not only prevented a complete understanding of the structure but greatly inhibited the overall performance. Clemson University researchers utilized hydrothermal growth to develop a new crystal with the same formula as SBBO, but the disordered oxygen atoms are completely removed. This results in a new structure and appears to perform much better than any previous material. Preliminary data shows very high conversion efficiency 3-4 times the industry standard. To date, researchers have demonstrated growth of single crystals 1-2mm.

Application

Advanced materials; UV solid state lasers

Development Stage

Proof of Concept

Advantages

- Utilizes hydrothermal growth the create crystals, resulting in ordered crystals with a new structure
- Eliminates disordered oxygen atoms, demonstrating better nonlinear optical performance with a higher conversion efficiency
- Creates harder crystals compared to existing materials, making it easier to process, cut and polish

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Utility	United States	NA	NA	2017-002	Dr. Joseph Kolis Colin McMillen

About the Inventor

Dr. Joseph Kolis

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Dr. Joseph Kolis 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.

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