Terbium Oxyhydroxide for Better Faraday Rotators

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Novel, hydrothermally-grown crystals protect diodes in high-power lasers

Market Overview

This crystal growth method utilizes a hydrothermal process to produce single crystals for use in high-power industrial lasers. The global market for industrial lasers is projected to grow from $4.6 billion in 2015 to $6.3 billion by 2020, reflecting a sustained increase in manufacturing interest. The industry standard, Terbium Gallium Garnet (TGG), is manufactured with a coloring that reduces crystal performance and contains expensive Gallium, making it both commercially and technologically inefficient. Clemson University Researchers have developed a technique to grow Terbium Oxyhydroxide (TbOOH) crystals with improved optical properties, made only of Terbium. The resulting crystal shows improved performance as a faraday isolator in high-powered lasers.

Technical Summary

The Terbium Oxyhydroxide (TbOOH) crystal has been previously described, but was believed to be unsuitable for application in laser technology due to size constraints. Clemson University researchers have gone beyond traditional melt, flux, and pull methods to hydrothermally grow a crystal with the TbOOH formula in significantly larger sizes suitable for use as a faraday isolator. These crystals are colorless and transparent, eliminating the brown color defect found in commercially available TGG crystals. Preliminary data also shows a Verdet number of 70 for these TbOOH crystals as opposed to 40, which means smaller crystals can yield equal performance. To date, Clemson researchers have demonstrated growth of single TbOOH crystals 5-8 mm in size.

Application

Industrial Lasers, Manufacturing

Development Stage

Prototype

Advantages

- Crystals utilize Terbium instead of Gallium feedstock, reducing manufacturing costs
- Product can be used interchangeably with the current industry standard, making its adoption into existing laser design easy
- Crystals are transparent and demonstrate a Verdet constant almost twice that of the industry standard, improving performance while requiring less manufacturing material

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	62/532,662	N/A	2017-004	Dr. Joseph Kolis

About the Inventors

Dr. Joseph Kolis

Professor of Inorganic Chemistry at Clemson University

Dr. Joseph Kolis received his Ph.D. in Organometallic Chemistry from Northwestern University and conducted postdoctoral research at McMaster University. Dr. Kolis is a founding member of COSMET, Center for Optical Materials Science and Engineering Technologies at Clemson 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 NSF award for Special Creativity and the Alfred P. Sloan Fellowship and holds over eight patents.

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