Materials with Large Nonlinear Optical and Electro-Optical Performance

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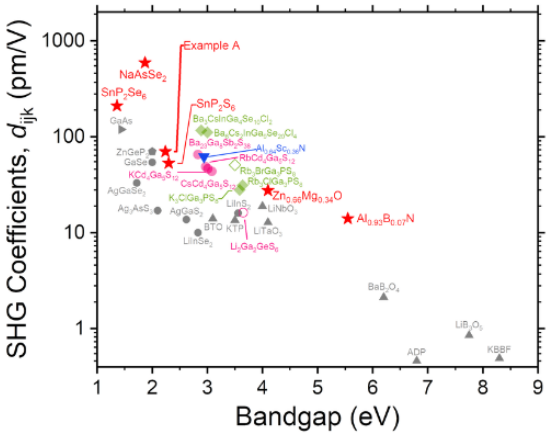

This figure shows the inverse relationship between the second-order optical nonlinearity, dijk, versus the electronic bandgap of various Non-Linear Optical (NCO) crystals.

Technology Summary

The inventors successfully grew large high-quality crystals having a chalcopyrite structure using a novel synthesis method that avoids using toxic chemicals. The uniaxial crystals exhibit a giant SHG coefficient of ~70pm/V at the fundamental wavelength of 1550nm, which is much larger than the commercial infrared NLO crystals and other NLO materials with the same bandgap. The crystals show excellent application value in frequency conversion such as frequency doubling, sum frequency, difference frequency, and down conversion in the IR laser system. Second-order optical nonlinearities showing a clear quadratic dependence on the input power confirmed the second order NLO effect. Third-order nonlinearities leading to the third harmonic generation and nonlinear absorption and nonlinear refraction are also superior, with fourth and even higher order nonlinearities expected to be large.

Application & Market Utility

This family of crystals exhibit superior electro-optic coefficients that promise orders of magnitude improvement in energy efficiency. This discovery may make nonlinear optical switching a compelling technique in photonic signal processing. These novel IR NLO crystals with superior optical properties have potential utility for next generational infrared laser system with wide tunability and high efficiency for broad applications such as communications, sensing and spectroscopy, including environmental monitoring, countermeasure, and laser surgery

Next Steps

The researchers are exploring other synthesis methods to grow cm-sized single crystals, including from additional compounds within this family. Millimeter sized samples of these crystals and polycrystalline materials may be available to evaluate.

TECHNOLOGY READINESS LEVEL 4

Seeking

Licensing | Research

Keywords

- Laser
- Communication System
- Sensing
- Spectroscopy
- Nonlinear optical crystal

Researchers

Venkat Gopalan
Professor of Materials Science and Engineering and Physics
Online Bio
Website

Zhiqiang Mao
Professor of Physics, Material Science and Engineering, and Chemistry
Online Bio
Website

Other Researchers

Originating College

College of Earth and Mineral Sciences, Eberly College of Science

Office of Technology Management Contact

Smith, Matthew
mds126@psu.edu
(814) 865-6277