Engineered Multifunctional Nanophotonic Materials for Ultrafast Optical Switching

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MURI website: http://muri24.creol.ucf.edu/

Objective

- Develop new generation of materials that exhibit large non-linear absorption (NLO) properties
  - Linear optics describes a system that responds proportionally to amount of light introduced
  - In contrast, NLO refers to systems that can absorb light and transfer absorbed energy to another molecular system

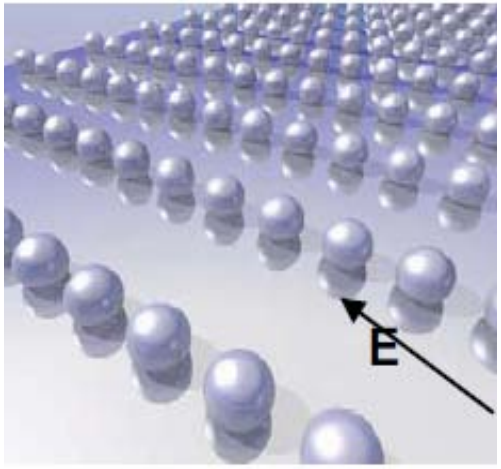
Approach

- Synthesize series of nanoparticles, charge-transfer materials, and polymethine dyes and determine NLO-enhancing potential
  - Charge-transfer materials can enhance energy-absorption of a composite material
  - Polymethine dyes can absorb energy at predefined ranges

Technical Success

- New type of quantum dots surrounded by thin metal shells found to enhance non-linear absorption of a material
  - Potentially useful in designing materials that allow ultrafast optical switching
- Adding layers of metal shells found to enhance NLO by 10x

Silver nanoparticle distribution assayed for NLO effects: light was introduced to this array at the direction indicated (E)



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Application

- Can provide a system that can amplify or absorb energy at given wavelength and then designed to emit light of higher or lower energy
- Potential to revolutionize telecommunications industry
- Could lead to improved visible-imaging applications
- Technology transfer in place with AFRL for use of materials for far-IR wavelengths
- MURI team established interactions with Andy Mott at ARL Adelphi regarding progress in optical switching materials

Potential Payoff

- High-speed interference-free devices on a microchip, useful for rapid, long-range communication
- Visors to protect the Soldier from sunlight or high-powered lasers (without interfering with normal visibility)