OSE Seminar Series

Compound Semiconductor Epitaxy Enabling Optical Science and Technology

Dr. Jeff Cederberg

Sandia National Laboratories, Albuquerque, NM

Thursday, December 1, 11:00 AM, *Physics and Astronomy, Room 190*

ABSTRACT: The ability to generate tailored crystalline semiconductor structures allows the investigation of new physical phenomena and the application of well understood phenomena to existing problems. One technique capable of generating such structures is metal-organic vapor phase epitaxy. Application of this technology is at a nexus of many fields: physics, chemistry, materials science, and engineering. In spite of years of effort advancing the science of epitaxial crystal growth, the implementation remains an empirical science. I will provide a brief overview of this technology, highlighting some of its achievements and identifying areas where development is needed. The focus of this seminar will be specific examples of research at Sandia National Laboratories that utilizes semiconductor heterostructures in various forms.

1) Extraordinary transmission by surface plasmons supported by metal gratings was pioneered in the visible and near-infrared by Ebbessen and co-workers. We have investigated similar phenomena in the thermal infrared. Tuning the transmission frequency is achieved with controlled doping of the GaAs layer or electrically through Joule heating. Other approaches to achieve active control of the response will be discussed.

2) Q-switched lasers based on Nd^{3+} doped insulators emit at 1.06 μm. We are investigating the use of quantum well heterostructures based on AlGaInAs alloys as Q-switches. The structures consist of AlGaInAs quantum wells in an AlInAs matrix grown on InP substrates. Following extensive materials characterization, we demonstrated passive Q-switching of a diode-pumped Nd:YVO_4. The performance of our semiconductor saturable absorber suggests routes to achieve low voltage active Q-switches based on the quantum confined Stark effect.

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Biography: Jeff Cederberg has been involved with various aspects of crystal growth for over 15 years. Jeff earned a B.S. in chemical engineering from Montana State University in Bozeman in 1994. He went on to attend the University of Wisconsin – Madison and earned a PhD in Chemical Engineering under the direction of Prof. Thomas Kuech. Upon graduation in 2000, he took a post-doctoral position at Sandia National Laboratories in Albuquerque, NM. In 2002, he was promoted to be a member of technical staff at Sandia. Jeff has been involved with many aspects of the materials science and device physics associated with thin film semiconductors during his career. As a graduate student, he investigated the electrical properties of point defects in semiconductors alloys. As a post-doc, he synthesized InGaAsSb alloys for thermophotovoltaic diodes and investigated the formation and optical properties of InGaAs self-assembled quantum dots on GaAs. As a staff member, he has worked on the development of lattice-mismatched InGaAs-based thermophotovoltaics and the integration of GaAs with Si using intermediate Ge layers. Currently, he is investigating semiconductor materials for control of both Q-switched and ultrafast solid-state lasers. Jeff is on the Executive Committee for the American Conference on Crystal Growth and a member of the Materials Research Society.

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