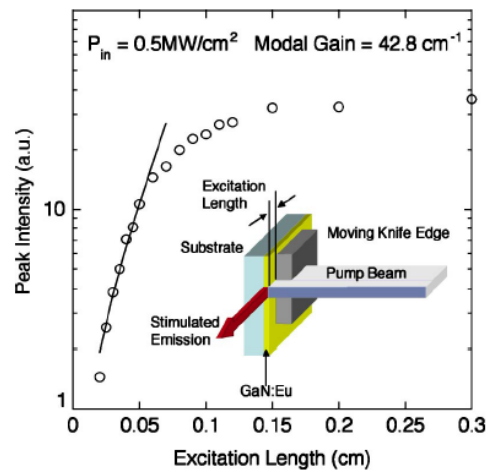
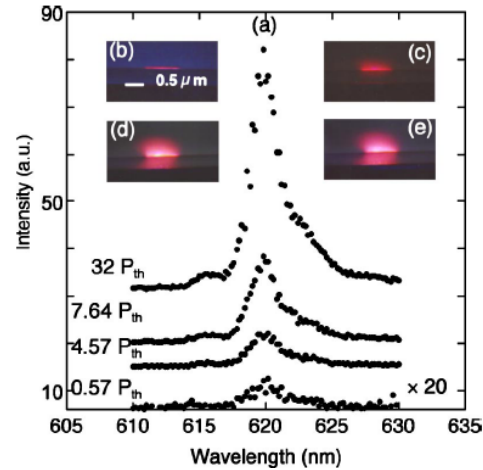


## Rare-earth-doped gallium nitride lasers

Because rare-earth ions exhibit inner-shell transitions that produce sharp photoemission lines with wavelengths ranging from the UV to the near-IR, they can be used in solid-state lasers that are optically pumped and have an insulating host. To develop an electrically pumped rare-earth laser, however, semiconductor rather than insulator hosts are required. Scientists from the Nanoelectronics Laboratory of the University of Cincinnati (Cincinnati, OH) have demonstrated rare-earth-based lasing action in a semiconductor host.

Using molecular-beam epitaxy, europium (Eu)-doped gallium nitride was grown on a 10-mm-square sapphire substrate resulting in a 0.6- $\mu\text{m}$  active layer doped with approximately 1 to 3 atomic percent Eu. After pumping the region with a nitrogen laser at 337.1 nm and blocking the surface emission, lasing was observed at the edge of the doped film at the dominant emission-peak wavelength of 620 nm at a threshold of 10  $\text{kW}/\text{cm}^2$ . By increasing the pump power above threshold, the modal gain was measured to be  $43 \text{ cm}^{-1}$ . This low-threshold pump power and strong modal gain are promising indicators for achieving electrically pumped lasing from this material combination. Contact Andrew J. Steckl at a.steckl@uc.edu.



## Laser action in Eu-doped GaN thin-film cavity at room temperature

J. H. Park and A. J. Steckl<sup>(a)</sup>

*Nanoelectronics Laboratory, University of Cincinnati, Cincinnati, Ohio 45221-0030*

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Rare-earth-based lasing action in GaN is demonstrated. Room-temperature stimulated emission (SE) was obtained at 620 nm from an optical cavity formed by growing *in situ* Eu-doped GaN thin films on sapphire substrates. The SE threshold for optical pumping of a  $\sim 1$  at. % Eu-doped GaN sample was  $\sim 10 \text{ kW}/\text{cm}^2$ . The SE threshold was accompanied by reductions in the emission linewidth and lifetime. A modal gain of  $\sim 43 \text{ cm}^{-1}$  and a modal loss of  $\sim 20 \text{ cm}^{-1}$  were obtained. © 2004 American Institute of Physics. [DOI: 10.1063/1.1821630]