הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Monday, July 7th, 2025 at 13:30

Room 5

Superior heat dissipation in transparent ceramics for solid-state laser applications

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Ph.D. Seminar

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Power-scaling of solid-state lasers (SSL) is fundamentally limited by the thermo-optical properties of the gain medium. Thermal management is a significant challenge in the design of high-performance, high-energy lasers. The major gap in existing SSL technology is their relatively low efficiency and poor uniformity, due to undesired thermal effects. For example, thermal lensing, which arises from localized changes in the refractive index induced by thermal gradients within the gain medium, as well as material degradation caused by mechanical stress. One promising way to overcome this gap is ceramic gain materials with significantly improved heat dissipation and high tenability. Recent approaches tackling these challenges are: specially designed structures of gain medium elements, ceramic composites and high thermal conductivity ceramic host for active Rare-Earth (RE) dopants.
This research aims to investigate high thermal conductivity ceramic composites as an effective, heat-dissipating gain medium for solid-state lasers. We proposed Nd:YAG-MgO/sapphire combined structures, where Nd:YAG is a gain material and MgO or sapphire act as transparent heat sinks.
This seminar presents two primary components of this research. The first segment focuses on the fabrication of transparent ceramics using spark plasma sintering (SPS), emphasizing strategies for minimizing carbon contamination during the process. Subsequently, the latter segment details the investigation of transparent ceramic composites obtained through a glass bonding method.

Refreshments will be served at 13:15.