הטכניון מכון טכנולוגי לישראל
TECHNION Israel Institute of Technology

Faculty of Mechanical Engineering
הפקולטה להנדסת מכונות

MECHANICAL ENGINEERING GRADUATE STUDENT SEMINAR SERIES

Sunday, June 7, 2026, at 12:30, Lady Davis Building, Auditorium 250

and ZOOM

Why we opened a "nail-salon" in a Zero-G airplane

Investigation of photopolymer thermal behavior in microgravity

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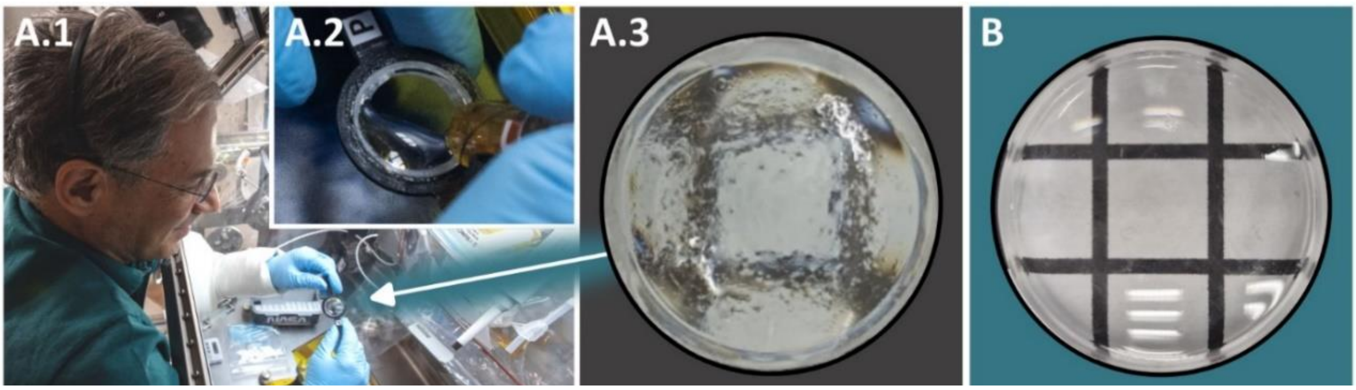
Future long-duration space missions will require in-situ, on-demand manufacturing of tools and components. Photopolymer-based processes are attractive for this purpose due to their low energy requirements and volume efficiency. However, photopolymerization generates significant heat, which is difficult to dissipate in microgravity where natural convection is absent, leading to defects such as surface blistering and deformation. In this work, we combine experimental studies and modeling to address these thermal challenges. We report results from International Space Station (ISS) experiments and dedicated parabolic flight campaigns, which confirm that suppressed convective heat transfer in microgravity exacerbates thermal buildup and defect formation. Building on these observations, we present a predictive thermal model that couples heat transfer, light absorption, and evolving material properties to simulate polymerization and temperature evolution under terrestrial and microgravity conditions. Applying the model to conditions of the ISS experiments accurately reproduces experimentally observed blistering. Beyond retrospective analysis, the model functions as a design tool for defect-free in-space manufacturing, enabling selection of polymer properties, exposure strategies, and environmental conditions that together inhibit excess heat buildup, paving the way for scalable, reliable in-situ manufacturing during future missions.



A.1. Eytan Stibbe demonstrating in-space lens manufacturing with Fluidic Shaping aboard the International Space Station. **A.2.** A photopolymer resin is injected onto a frame. In microgravity, surface tension drives the liquid to a smooth spherical surface. **A.3.** Solidification by UV curing resulted in unexpected surface defects on some of the samples, due to excess heat buildup. **A.4.** Reference lens fabricated on earth under the same conditions (apart from gravity).

Seminars Coordinator: Prof. Steven Frankel.