MECHANICAL ENGINEERING, MSc SEMINAR

Thursday, November 20, 2025 at 13:30-14:00, D. Dan and Betty Kahn Building, Room 217
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Thermoforming of Polyetherimide (PEI) Plates for Axisymmetric Structures

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Abstract

High-performance polymers such as ULTEM™ (polyetherimide, PEI) are increasingly employed in demanding engineering applications owing to their exceptional thermal stability, mechanical strength, optical clarity, and chemical resistance. This study focuses on the thermoforming of PEI plates to produce axisymmetric structures, emphasizing process optimization and the preservation of functional properties. The main objective is to fabricate components with controlled thickness, geometry, and surface quality while maximizing material efficiency and minimizing defects. Achieving these goals requires precise regulation of the material's rheological behavior through spatially zoned, time-dependent heating supported by model-based control.

We systematically investigated the effects of key processing parameters: draw ratio and forming temperature, on the post-forming mechanical and optical performance of PEI plates. Finite Element Method (FEM) simulations were employed to guide process optimization and establish forming strain limits. Results from one-dimensional deformation experiments revealed that mechanical integrity was primarily governed by:

- Maintaining the forming temperature of both the PEI plate and tooling near the glass transition temperature (≈220 °C), which enabled an equivalent strain of up to 80%.
- Pre-drying the PEI plates for at least five hours at 150 °C prior to thermoforming.

The final axisymmetric geometries were successfully achieved, with CT scans confirming the absence of critical defects. The intrinsic properties of the PEI material were largely preserved: differential scanning calorimetry (DSC) and thermal expansion analyses indicated negligible microstructural changes, while the dielectric constant remained stable up to 20 GHz.

In summary, careful control of process temperature and draw ratio enabled the production of defect-free PEI axisymmetric components (e.g., domes) with retained mechanical and functional properties. The results demonstrate a robust, model-driven thermoforming methodology suitable for advanced glassy polymer manufacturing applications.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Prof. Sefi Givli