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|  |  | 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, August 18th, 2025 at 13:30**

**Room 1**

**Mechanochemistry in Epoxy-Amine Polymers**

**Raz Azar Buzaglo**

**MSc Seminar**

Advisor: Prof. Charles E. Diesendruck

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Mechanochemistry, the transduction of mechanical force into chemical reactivity, has emerged as a powerful strategy for inducing molecular transformations within polymer systems. While extensively studied in thermoplastics, its application to epoxy-amine based materials remains limited due to the crosslinked nature of conventional networks. In this study, I synthesized a novel thermoplastic epoxy-amine polymer incorporating up to 10 mol% of a covalently bound rhodamine 6G mechanophore, with the goal of enabling optical detection of the polymer mechanochemical activity under sonication in order to investigate mechanochemistry in epoxy-amine segments which could inform us of the process in thermosets.

A central finding of this research is the development of a new approach to calibrate and quantify mechanochemical activation in epoxy-amine thermoplastic systems. By embedding a covalently bound optical mechanophore into a polymer with chemical similarity to crosslinked thermosets, the study offers a platform for probing mechanochemistry in systems where direct measurement is typically intractable. Furthermore, the synthesized thermoplastic epoxy-amine polymer exhibits exceptional mechanical stability and resilience. Even under prolonged ultrasonication at high amplitudes or ball milling griding, the polymer backbone remained intact, showing no measurable degradation in molecular weight (Mw). This remarkable resistance to mechanical breakdown highlights its suitability for demanding industrial applications where durability and mechanical robustness are critical, such as aerospace, construction, and high-performance coatings.

Simultaneously, the study demonstrates that mechanical elongation of the polymer chains without bond scission is sufficient to activate an embedded mechanophore. UV-Vis spectroscopy revealed a time-dependent increase in absorbance at 538 nm, corresponding to ring opening of the rhodamine 6G unit when mechanical stress is applied. After 180 min of sonication, mechanophore activation reached ~56%. Control experiments using non-covalently mixed mechanophores showed no activation, validating that mechanical force must be transmitted through covalent linkages for activation to occur.

These findings confirm that the synthesized system enables dual functionality: structural integrity under mechanical stress and molecular-level force sensing via mechanophore activation. This work thus provides a valuable platform for designing smart polymeric materials capable of withstanding extreme conditions while simultaneously reporting on mechanical stimuli.

Refreshments will be served at 13:15.