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| הפקולטה להנדסה כימיתע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Monday, March 28th, 2022 at 13:30**

**Room 6 # via Zoom:** <https://technion.zoom.us/j/97577956516>

**Mechanics of hybrid organic-inorganic materials fabricated by sequential infiltration synthesis (SIS)**

**Shachar Keren**

**PhD Mid-Seminar**

Advisors: Prof. Tamar Segal-Peretz (1), Prof. Noy Cohen (2)

1. Department of Chemical Engineering, (2) Department of Materials Science and Engineering,

Technion – Israel Institute of Technology

Hybrid organic-inorganic materials have drawn increased interest in the last decades due to their synergic properties. Control over the mechanical properties of hybrid organic-inorganic nanomaterials is central to their implementation in a wide range of applications, including energy-absorbing materials, modified actuators, and protective coatings. In recent years, sequential infiltration synthesis (SIS) has emerged as a promising new technique for fabricating hybrid materials with nanoscale precision. In SIS, inorganic materials are grown within polymers from vapor phase precursors using atomic layer deposition (ALD) chemistry. Several studies have demonstrated the potential of SIS to tune the mechanical properties of polymers. However, a full understanding of the relationship between the nanoscale structure, composition, and nanostructure mechanical behavior is still ongoing.

This research studies the mechanical response of pristine and hybrid thin films fabricated via SIS using a combined experimental and theoretical approach. Hybrid thin films were fabricated by growing AlOx within PMMA films via SIS process, using trimethylaluminum and H2O as precursors. *In-situ* microgravimetric measurements were used to assess the inorganic mass gain, and transmission electron microscopy (TEM) imaging was used to characterize the distribution of AlOx within the PMMA films. The mechanical responses were studied with nanoindentation combined with scanning electron microscopy (SEM).

In addition, we are working on understanding the role of SIS at the interfaces of polymer-based adhesive joints. Preliminary results show an increase in joint strength following SIS treatments.

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**Wolfson Department of Chemical Engineering Seminar**

**Monday, March 28th, 2022 at 14:00**

**Room 6 # via Zoom:** <https://technion.zoom.us/j/97577956516>

**Electrospun PZT nanofiber-based composites for vibration control**

**Noam Shmilovich**

**MSc Seminar**

Advisor: Prof. Gideon Grader

Department of Chemical Engineering, Technion-Israel Institute for Technology

Vibrations are an undesirable, yet common byproduct in many engineering applications. The existence of vibrations in a mechanical system can impair its durability and result in limited accuracy and performance. Piezoelectric materials can transform mechanical energy into electrical energy and vice versa. This property makes them particularly useful in vibration control systems. Polycrystalline ceramic materials, such as lead zirconate titanate (PZT - $Pb(Zr\_{x}Ti\_{1-x}O\_{3})$), can be processed to exhibit significant piezoelectric properties. However, industrial applications of PZT are hindered by its low flexibility and brittle nature. PZT–polymer composites have the potential to overcome these limitations by combining the electromechanical properties of PZT and the mechanical flexibility and processing possibilities of polymers.

The relationship between the microscopic structure of a material and its macroscopic properties is well-known in material science. More specifically, the microscopic structure of the PZT will have a profound impact on the characteristics of the PZT-polymer composite. PZT is generally prepared via solid state chemistry. This preparation route results in a typical microparticulate structure. Electrospinning is a simple technique capable of generating various nanofibrous structures. Many researchers explored the link between PZT morphology and composite architecture on the resulting piezoelectric properties, but a systematic comparison between composites with different PZT morphologies is scarce. The focus of this research is a comparison between the piezoelectric properties of powder-based, and fiber-based composites. The fruits of this research could be used to produce highly optimized composites for vibration control systems.