Faculty of
Mechanical Engineering

הטכניון מכון טכנולוגי לישראל
TECHNION Israel Institute of Technology

הפקולטה
להנדסת מכונות

SEMINAR - סמינר

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים **ביום א'** 4.06.2017 (י' בסיון, תשע"ז), בבניין דן קאהן, אודיטוריום 1, 13:30.

ירצה:

Dr. Dimitry Papkov

Mechanical and Materials Engineering Department
University of Nebraska-Lincoln, U.S.A

על הנושא:

Morphological and Structural Control during Continuous Nanofiber Nanomanufacturing for Superior Mechanical Properties

The seminar will be given in English

להלן תקציר ההרצאה:

Classical manufacturing techniques of advanced polymeric fibers rely on a combination of high polymer crystallinity and high degree of macromolecular alignment to achieve superior mechanical properties. As a consequence, advanced polymeric fibers such as Kevlar and Spectra possess extraordinary strength, but low strains to failure and toughness (energy absorption during rupture). Recent analysis of electrospun polyacrylonitrile (PAN) nanofibers (NFs) in the ultrafine (100-250 nm) diameter range showed strong simultaneous size effects in strength, modulus, and toughness. Finest nanofilaments exhibited strength approaching that of advanced structural fibers, while exceeding their toughness by almost an order of magnitude. Structural investigations and comparison to annealed NFs allowed attribution of this unusual combination of mechanical properties to high degree of macromolecular alignment in conjunction with low crystallinity. Here we demonstrate that it is possible to control the NF morphology and structure by changing the nanomanufacturing parameters. Reductions in crystallinity through changes in the solvent system resulted in further increases in strain to failure and toughness. Surprisingly, the change of the solvent system also resulted in improvements in NF strength and modulus. Improved polymer chain alignment in the new systems was observed. It was attributed to the improved drawability of NFs electrospun from the new solvent systems. Importantly, the major improvements in mechanical properties observed in this study happened in the intermediate (250-500 nm) diameter region. Average values for true strength, modulus, and toughness increased in this diameter range by up to a factor of 3 compared to the previous results. The best results for these properties approached and even exceeded those previously reported for the ultrafine diameter region. NFs with larger diameters are easier to produce and handle, simplifying upscaling of the process. Differences in the correlation slopes between mechanical properties in the different property spaces demonstrated here allow for optimization and tailoring of NF properties for specific applications. As a result, the reported improvements in mechanical properties of NFs in the intermediate diameter range can lead to inexpensive, simultaneously strong and tough structures for safety critical applications. The proposed structural explanations of NF mechanical behavior can potentially challenge the prevailing paradigm in advanced fiber development.

מארח: פרופ' איל זוסמן

בברכה,

פרופ"מ שמואל אוסובסקי
מרכז הסמינרים