



## סמינר מחלקתי – הנדסת חומרים

הנכם מוזמנים בזאת לסמינר מחלקתי  
אשר יתקיים ביום ה', 20 במרץ 2025, כ' באדר תשפ"ה,  
בשעה 11:00, בניין 51 באולם 15

### “Journey from nano/micro-structure to medical device and material regeneration”

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Musculoskeletal diseases are the second largest cause of disability, affecting 1.7 billion people worldwide. Bone, back and joint pain disorders cost the EU's economies 200 billion each year and are the primary cause of UK absenteeism from work with an estimated 31 million days work lost per year.

Specifically in my research group we focus on developing functional nanocomposite materials and medical device coatings for orthopaedic application (such as TJR).

Total joint replacement (TJR) surgery are causing two main problems to patients: aseptic loosening and Prosthetic joint infections (PJI). Aseptic loosening is a consequence of an extended inflammatory reaction induced by wear particles and one of the most common complications of TJR causing the revision of about half procedures. These issues are governed by the deterioration of the moving components, producing particles (wear debris) associated with the metals, bone cement, and UHMWPE materials initiating an immune response leading to osteolysis. The effect of wear debris exposure on mesenchymal and osteoblast (both rodent and human) cells on cell nanomechanical and adhesive properties was studied using AFM indicating that Cobalt nanoparticles were more damaging on all cell types than Titanium and polymeric particles. Despite its high incidence, in the last decade no therapeutic approach has been found to treat or avoid aseptic loosening, leaving revision as only effective treatment for this condition. The local delivery of anti-inflammatory drugs to modulate wear-induced inflammation has been regarded as a potential therapeutic approach to avoid aseptic-loosening. In this context, we developed and characterised an anti-inflammatory drug-eluting implant model system.

PJI is a relatively rare, occurring in 1-2% of primary and ~10% of revision TJR, but extremely impactful surgical consequence. The use of antibiotic loaded poly-methyl methacrylate (PMMA) bone cement is considered a well-established standard in the treatment and prophylaxis of PJI. Currently used antibiotic loaded bone cements have many limitations, including burst release of < 10% of antibiotic added. This burst release falls rapidly below inhibitory level within few days, which leads to selection of resistant antimicrobial strains and does not provide prophylaxis from early and delayed stage infection. Nanocomposite bone cements were developed; drug release was observed for over 30 days at concentrations 3 times higher than the commercial formulation containing the same amount of antimicrobial, where burst release for few days was observed. Moreover, the nanocomposites showed efficacy and good cytocompatibility in vivo. No adversely effects were determined in the nanocomposite bone cement compressive strength, bending and fracture toughness properties.

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