

# Micromechanics in biology and medicine

## 1 | INTRODUCTION

Micromechanics is the study of materials at the level of their constituents to describe the interactions of the microstructures and other micro-scale effects. Micromechanical approaches have wide applications in biology and medicine due to the nature of biological tissues and the size of micro-biomedical devices. Micromechanical experiments, continuum micromechanics, and computational multi-scale models of materials with an emphasis on the connections between material properties and mechanical responses at a micron length scale are significantly essential to design and manufacture the mechanical components of micro-biomedical devices and comprehend the behaviour of biological tissues. The micro-scale mechanics of biological tissues is a multidisciplinary and rapidly expanding area of research, which deals with the lower-scale effects on the mechanical behaviour of biological tissues, such as bone, brain, muscle, vasculature, skin, etc. In fact, there are different micro-scale deformations, interactions, and movements within these tissues (e.g. microstructural or bi-phasic properties) affecting the mechanical response of the materials. The micromechanical characteristics of a material are key to find how it interacts with its physical environment, which eventually modulates the functionality of the material. Such micro-biomechanical effects stem from the structural and architectural arrangements and the hierarchical nature of biological tissues. This Virtual Collection presents the latest and cutting-edge experimental, computational, and theoretical research on the mechanical properties/behaviours of biological tissues and therapeutics to take into account the micro-scale effects, such as microstructures deformations, micro-scale inhomogeneity, micro-damage, micro-porosity, etc., and the mechanics of cells and cell-substrate interactions.

## 2 | PAPERS IN THE VIRTUAL COLLECTION

In this Virtual Collection, we received six manuscripts, six of which underwent peer review. Of these six manuscripts, three have been accepted for publication in the Virtual Issue demonstrating a high quality and novel insights into Micromechanics in Biology and Medicine.

Rostami et al. characterised folic acid-functionalised PLA-PEG nanomicelles to deliver Letrozole for the effective treatment of cancer. In silico methods including docking approach, molecular dynamics simulation, and free energy calculations were used for the characterisation studies of PEG-FA and PLA-PEG nanocarriers in delivering Letrozole as an aromatase inhibitor in cancer cells. It was demonstrated the PLA-PEG-FA can be considered a versatile nanocarrier that can increase the effectiveness of aromatase inhibitors while reducing the side effects of the drug.

Alahdal et al. presented a 'green' approach to synthesise iron/gold Auroshell nanoparticles and tested with normal HUVEC cells and glioblastoma cancer cells. The Auroshell nanoparticles were found to have minimal toxicity within a safe range for normal cells. When transferred to the tumour tissue, these nanoparticles demonstrated a uniform heating (hyperthermia treatment) of malignant tumours.

Alzahrani et al. used a MEMS microcantilever-based biosensor functionalised with the UL83-antibody of Human Cytomegalovirus to detect the UL83-antigen of Human Cytomegalovirus at different concentrations. The effective detection of the UL83-antigen was demonstrated with a high selectivity of the antigen. This technique shows the potential for the fabrication of portable, low-cost biosensors for real-time diagnostics.

## 3 | SUMMARY

The articles published in this Virtual Collection demonstrate the importance of micromechanics in biology and medicine. The importance of micromechanics in the study of biological phenomena and effective treatments using state-of-the-art nanotechnology is clearly demonstrated opening the door for further exploration and research in this exciting area.

## AUTHOR CONTRIBUTIONS

**David B. MacManus:** Conceptualization; project administration; writing – original draft; writing – review & editing. **Majid Akbarzadeh Khorshidi:** Conceptualization; project administration; writing – original draft; writing – review & editing. **Mazdak Ghajari:** Project administration; writing – original draft; writing – review & editing. **Hamid M. Sedighi:**


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David B. MacManus<sup>1,2</sup>   
Majid Akbarzadeh Khorshidi<sup>3,4</sup>  
Mazdak Ghajari<sup>5</sup>  
Hamid M. Sedighi<sup>6</sup>

<sup>1</sup>*School of Mechanical & Manufacturing Engineering, Dublin City University, Dublin, Ireland*

<sup>2</sup>*School of Mechanical & Materials Engineering, University College Dublin, Dublin, Ireland*

<sup>3</sup>*Ferdowsi University of Mashhad, Mashhad, Iran*

<sup>4</sup>*School of Mechanical, Manufacturing & Biomedical Engineering, Trinity College Dublin, Dublin, Ireland*

<sup>5</sup>*Dyson School of Design Engineering, Imperial College London, London, UK*

<sup>6</sup>*Department of Mechanical Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran*

## Correspondence

David B. MacManus.

Email: [david.macmanus1@ucd.ie](mailto:david.macmanus1@ucd.ie)

## ORCID

David B. MacManus  <https://orcid.org/0000-0003-2959-698X>