Mechanical Behaviour of Single Cells and Tissues – Consolidation Theory, Modelling & Experiments

YuanTong Gu

School of Chemistry, Physics and Mechanical Engineering,
Queensland University of Technology, 2 George St, Brisbane, QLD 4000. Australia.

yuantong.gu@qut.edu.au

The mechanical properties of cells and tissues play important roles to fulfil their biological functions. However, only limited research has been conduced to investigate mechanical properties of single cells and tissues because of the significant challenges including the high strain-rate dependency, lack of suitable constitutive laws and complexity of their mechanical deformation behaviours. To bridge this research gap, the aim of this study is to explore the strain-rate dependent mechanical behaviour of single cells and tissues. Firstly, Atomic Force Microscopy (AFM) and indention experiments are conduced to obtain the force-indentation curves of single cells and tissues at different strain-rates. These results are then employed in the inverse finite element analysis (FEA) to investigate a number of constitutive laws including the porohyperelasticity (PHE). It has found that the mechanical deformation properties of single cells and tissues are highly dependent on strain-rates. The deep mechanism is explored to find that the effect of fluid within the cell and the tissue. The suitable constitutive laws for different strain-rates are recommended for cells and tissues, respectively.