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Biophysical Modulation of Macrophage Behaviour in 3d Microenvironments

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Evidences suggest that mechanotransduction in immune cells has a crucial role in promoting immune cell recruitment, activation, metabolism and inflammatory function. However, prolonged and excessive mechanical stimulation can result in pathologies, such as fibrosis, cardiovascular disease and cancer. Although the associations between mechanical cues and cell behaviour in steady-state and disease have been identified, the regulatory mechanisms among different mechanical cues are not yet comprehensively illustrated.

Here, we aim to rationalize the role of biomaterial surface topography on macrophages morphology, motility and metabolic activity. Specifically, we focused on the influence of prescribed surface topographies, fabricated by mechanical wrinkling of soft elastomeric bilayer, on macrophage remodelling, migratory potential, and proliferation.

Our results demonstrated that, depending on the wrinkles characteristic length scales (i.e., wavelength and amplitude), macrophages adopted three different morphologies: spindle-like, egg-like and ball-like displaying differences in mechanical properties and motility. Additionally, we observed differences in cytokines secretion in response to changes in surface topography, providing a correlation between cell immune response and material surface roughness.