CONTROL OF CELL MORPHODYNAMIC AND DISPLACEMENT ORIENTATION BY PRECISE TUNING BETWEEN SUBSTRATE NANOPATTERNING AND RIGIDITY

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Abstract

Cell adhesion and migration are strongly influenced by extracellular matrix (ECM) architecture and rigidity, but little is known about the concomitant influence of such environmental signals to cell responses, especially when considering cells of similar origin and morphology, but exhibiting a normal or cancerous phenotype. Using nanopatterned polydimethylsiloxane substrates (PDMS) with tuneable stiffness (500kPa, 750kPa, 2000kPa) and topography (lines, pillars or unpatterned), we systematically analyse the differential response of normal (3T3) and cancer (SaI/N) fibroblastic cells. Our results demonstrate that both cells exhibit differential morphology and motility responses to changes in substrate rigidiy and nanotopography. 3T3 polarization and spreading are influenced by substrate nanotopography and rigidity. The cells exhibit a persistent type of migration, which depends on the substrate anisotropy. In contrast, the dynamic of SaI/N spreading is strongly modified by the substrate topography but not by substrate rigidity. SaI/N morphology and migration seem to escape from extracellular cues: the cells exhibit uncorrelated migration trajectories and a large dispersion of their migration speed, which increases with substrate rigidity.

In conclusion our results highlight that the normal cell morphodynamic could be controlled by a precise tuning between substrate nanopatterning and rigidity. These results may be applied for the fabrication of specific substrates to be used in tissue engineering and for the gradation of the metastatic phenotype of adherent cells.