Effects of substrates nanopatterning on osteosarcoma cells behaviour

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Engineering of the cellular microenvironment has become an attractive strategy to guide cellular activities such as spreading, motility, proliferation and differentiation. From a technological perspective, the physical crosstalk between the cell and its surroundings represents a design parameter that may be modulated to achieve desired physiological outcome. In this study we present a surface engineering approach to tap into the physical crosstalk between the cell and its surroundings in order to modulate osteogenic anchorage-dependent differentiation and bone formation. The effectiveness of this approach was studied by comparing the cellular behaviour of human SOAS sarcoma cells on nanostructured silicon substrates with distinct nanoscale patterns.

Random nano-islands were realized by controlled deposition of tin on the polished side of silicon wafers by thermal evaporation. Four different shaped surfaces of nano structured substrates were used in this study. Silicon substrates present surface islands with diameters ranging from 10 to 35 nm and inter-island distances of 41 (B), 51 (E) or 80 (F) nm respectively. Substrate A is planar silicon used as control.

Cells were seeded at 5000/cm^2 on plastic or different silicon chips. Firstly we assayed the surfaces' adhesiveness and tested the distribution of cytoskeleton and focal adhesions molecules, no particular differences in the distribution of the different proteins were observed. Terminal differentiation of Saos-2 cells was analyzed by real time PCR. The expression of OP and BOSP genes seems to be differently regulated by the surfaces, in particular substrate E seem to exert in long term experiments the optimal response. Nanostructured substrates were observed to be superior to planar controls in the modulation of cell proliferation and differentiation. Our findings suggest that physical nano-scale topography presents an instructive background to guide cell behaviour by dictating the quality of cell adhesion and focal adhesion spatial distribution which in turn can control the fate of cells.

Key words
Biomaterials, Nanostructured matrices, Bone cell differentiation