

Micropatterning of two-dimensional nanomaterials to control stem cell behaviors

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Recently, the use of two-dimensional nanomaterials has emerged as an attractive way to steer stem cell behaviors. Here, we report a graphene oxide (GO) micropatterning technique that is effective to guide differentiation of human adipose-derived mesenchymal stem cells (hADMSCs) into two different lineages (osteogenesis and neurogenesis) in highly efficient manner. GO micropatterns with different geometry (e.g. dots, lines and grids) were generated on gold-coated glass substrate and were found to be generatable on a number of biocompatible substrates. In combination with cell repulsive material, the GO line and grid patterns were proven to effectively guide stem cell differentiation into osteoblasts (bone cells) and neuronal cells. The conversion efficiencies of hADMSCs were 54.5% and 30% higher than control groups for osteoblastic and neuronal differentiation, respectively, which are hard to be achieved using GO-coated substrates. The strategy developed in this study could be further applied to generate GO micropatterns on physical factor-controlled substrates, which could ultimately steer stem cell differentiation in a more efficient manner.