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Computer simulation of cell sorting on dynamic microstructured surfaces

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Cell sorting is a fundamental process in biology and biotechnology that enables the separation of heterogeneous cell populations based on their intrinsic properties. Among the various sorting strategies, affinity-based approaches exploit differences in cell-surface interactions to achieve selective cell attachment and detachment. Micropatterned adhesive surfaces provide a means to tune these interactions by controlling the surface coverage of adhesive domains, their geometry and adhesion strength. By combining these features with dynamic surface switching, the separation efficiency can be significantly enhanced through a multistage process in which the surface alternately promotes cell adsorption or desorption.

We report a computer simulation study of label-free cell sorting on dynamic microstructured adhesive surfaces, modelled as an array of randomly distributed circular adhesive domains. Cell detachment is induced by a repulsive force originating from a thermoresponsive polymer occupying the inter-domain regions. We investigate the effect of domain size on cell separation arising from sequential attachment-detachment events at fixed surface coverages of adhesive domains. For the multistage process, different scenarios of periodic surface switching are explored to optimize the efficiency of cell sorting.

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