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Independent Control over Surface Charge and Wettability Using Polyelectrolyte Architecture

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Abstract : Surface charge and wettability are two prominent physical factors governing cell adhesion and have been extensively studied in the literature. However, a comparison between the two driving forces in terms of their independent and cooperative effects in affecting cell adhesion is rarely explored on a systematic and quantitative level. Herein, we formulate a protocol which allows two-dimensional and independent control over both surface charge and wettability. This protocol enables the unambiguous comparison of the effects of these two properties on cell adhesion. This strategy is implemented by controlling both the relative thickness of polyion layers in the layer-by-layer assembly and the polyion side chain chemical structures. The 2D property matrix spans surface isoelectric point ranging from 5 to 9 and water contact angle from 35º to 70º, with other interferential factors (e.g. roughness) eliminated. The interplay between these two surface variables influences 3T3 fibroblast cell adhesion. The results show that both surface charge and wettability have an effect on its adhesion. The combined effects of positive charge and hydrophilicity led to the highest cell adhesion whereas negative charge and hydrophobicity led to the lowest cell adhesion. Our design strategy can potentially form the basis for studying the distinct behaviors of electrostatic force or wettability driven interfacial phenomena and serving as a reference in future studies assessing cell adhesion to surfaces with known charge and wettability within the property range studied here.

Keywords : cell adhesion, layer-by-layer, surface charge, surface wettability
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