Synergistic mechanotransduction of hierarchical structure to enhance the cardiomyocytes maturation

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The biophysical cues from the micro-and nanopatterned substrates have been explored to understand cellular interactions at the microenvironment. Considering the natural tissues consist of multiscale, the hierarchical topography mimicking the niche allows us to understand the gradual mechanotransduction. However, as the design of the substrate was relatively simple, the complex effects cannot be clarified. In this study, we developed the novel multiscale hierarchical substrates (MHS) combining nanopillar with micro-wrinkle, fabricated by the facile method in a large area. Sensing the topography, the cardiomyocytes (CM) were elongated and aligned. Interestingly, the CMs maturation was synergistically enhanced on the largely wrinkled MHS (λ: ~ 43 μm), due to the extremely enlarged CM-nanopillar interfaces within grooves and facilitated focal adhesion formation. In addition, the iPSC-CMs grown on MHS exhibited maturated α-actinin expression. Through systematical investigation of this work, we could rationalize each feature for CMs and provide insights into synergistic mechanotransduction of hierarchical topography.