Multi-scale Biomimetic Topography for the Alignment of Neonatal and Embryonic Stem Cell-derived Heart Cells.

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Public Summary:
Recent studies indicate that structure and function at the heart tissue level is exquisitely sensitive to mechanical cues at the nano-scale well as at the micro-scale level. Although fabrication methods exist for generating topographical features for cell culture, current techniques, especially those with nanoscale resolution, are typically complex, prohibitively expensive and not accessible to most biology laboratories. Here, we present a tunable culture platform comprised of surface structures that simulate the heart's complex and multi-scale architecture for facilitate the alignment cardiac cell into more functional tissue.

Scientific Abstract:
Nano- and micro-scale topographical cues play critical roles in the induction and maintenance of various cellular functions including morphology, adhesion, gene regulation and communication. Recent studies indicate that structure and function at the heart tissue level is exquisitely sensitive to mechanical cues at the nano-scale well as at the micro-scale level. Although fabrication methods exist for generating topographical features for cell culture, current techniques, especially those with nanoscale resolution, are typically complex, prohibitively expensive and not accessible to most biology laboratories. Here, we present a tunable culture platform comprised of biomimetic 'wrinkles' that simulate the heart's complex anisotropic and multi-scale architecture for facile and robust cardiac cell alignment. We demonstrate the cellular and sub-cellular alignment of both neonatal mouse cardiomyocytes as well as those derived from human embryonic stem cells. By mimicking the fibrillar network of the extracellular matrix, this system enables monitoring of protein localization in real time and therefore the high-resolution study of phenotypic and physiologic responses to in-vivo like topographical cues.