



Undergraduate Outstanding Research Award, 2023

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“Artificial Hearts: Photoacoustic-mediated heart organoid development for cardiovascular disease modeling”

Abstract

Growing cardiovascular disease incidence, particularly involving irreversible myocardial cell-death, drives novel pharmacological therapy and surgical intervention research. However, state-of-the-art treatment lags demand due to a fundamental technical mismatch between therapy screening preclinical models and clinical trials. To develop a preclinical cardiac model with clinical sensitivity, specificity, and biomimetic complexity, this thesis proposes a novel thin-film photoacoustic scaffold that exposes pluripotent cells to an embryomimetic pulse train and stimulates in vitro cardiac organogenesis. Cardiomyocytes directly cultured on the scaffold rapidly self-organize into an embryonic body and mature into a heart organoid morphology without sensitive growth factor concoctions or significant resultant size variance. As a preclinical model for cardiac therapy validation, this device may be a precursor for future regimens that repair myocardial insults and significantly improve long-term patient outcomes.