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# Approaches for Cardiomyocyte Maturation and Drug Toxicity Assessment through Mechanical Stimulation and AgNW Integration

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## Abstract

This study presents a pioneering approach to assess and enhance the maturation and contraction characteristics of cardiomyocytes. Through the integration of a mechanical stimulation (MS) system and a groove structure embedded with AgNW, cardiomyocyte alignment and growth were significantly improved under controlled tensile stress conditions. Real-time monitoring of tensile stress alterations using a laser vibrometer, coupled with precise displacement control through Arduino feedback, yielded valuable insights into the process. Notably, cardiomyocytes exposed to a cyclic tensile stress regime of 10% amplitude and 1 Hz frequency displayed enhanced alignment along the stress direction. Moreover, the MS system induced remarkable improvements in sarcomere length and more than threefold increase in Cx43 protein intensity. The innovative combination of groove structures and embedded AgNW within the proposed mechanical stimulation system holds great promise for advancing cardiomyocyte maturation and alignment, thereby augmenting the credibility of drug reactivity assessments, and advancing cardiovascular tissue engineering. This research pioneers a new direction for fostering the maturation of cardiomyocytes and demonstrates the potential of integrating mechanical stimulation systems with advanced materials to enhance cardiac tissue engineering and drug testing methodologies.

**Keywords:** Cardiomyocytes, Mechanical stimulation, Embedded-AgNW, Maturation, Contraction

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