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PI Micro-Cantilever Array Integrating Silicon Strain Sensors and MEA for Co-evaluation of Contractile Force and Field Potential of Cardiomyocytes

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Abstract

Concerns about cardiac safety are a leading cause for drug withdrawal from clinical trials and the market. Normally, drugs pose a potentially fatal arrhythmia risk by direct interaction with the electrophysiology of the heart. Nevertheless, recent research has indicated that a significant number of drugs also impact cardiac function through impairment of myocardial metabolism or cardiac structures (e.g. proteins, mitochondria). Here, we introduce a 24-well high-throughput assay platform comprising the polyimide (PI) microcantilever integrated with silicon strain sensors and microelectrode arrays (MEAs) for in vitro cardiomyocyte culture drug toxicity testing. The silicon strain sensors and MEAs have the capability to immediately detect cardiomyocyte contractility and field potential, allowing multifactorial detection. The cantilever is comprised of polyimide-based photoresist, KMSF 1000. The low Young's modulus (0.14 GPa) facilitates coexistence of miniaturized cantilevers with high-precision detection of cardiomyocyte contraction forces, while reduced residual stress enhances product stability and reliability. The 24-well, 96-cantilever array structure significantly increases assay efficiency and reliability. This platform appears appropriate for conducting cardiotoxicity screening tests during the initial phases of drug development.

Keywords: Drug screening platform, Polyimide microcantilever arrays, Silicon strain sensor, MEA, Cardiomyocytes.

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