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CEL-C advanced bioCD - A Lab-on-a-Chip centrifuge platform for single-cell electrophysiology study

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Ceratopteris richardii fern spores are an ideal model system for studying single-cell gravi-response due the ability to synchronize the development of the spores during culture. Previous work with the self-referencing probe and cell-electrophysiology lab-on-a-chip (CEL-C) technologies documented an asymmetric and directional transcellular Ca^{2+} concentration that is influenced by gravity. To further investigate the threshold of Ca^{2+} channel activation that generates the Ca^{2+} polarity in *C. richardii* spores, we have adapted the CEL-C device into a disk version called the bioCD. When the bioCD rotates in microgravity, different gravity thresholds can be experienced by individual fern spores. The fused-silica bioCD consists of thirty-two wells; each well houses a single spore. A pair of all-solid-state ion-selective electrodes in each well provides dual-electrode differential-coupling (DEDC) measurement of Ca^{2+} concentration at both sides of the spore. Our preliminary 1-g experiments reveal a DEDC signal of 0.4 V when the spore is repeatedly oriented at 180° to the gravity vector during the peak germination period which occurs at 6-9 hours from initiation of germination. This translates to a 22-fold change in calcium concentration between the two sides of the spores. However, when rotations were conducted after the germination period ended, no change in voltage was observed. The results imply that polarity development in fern spores is directed by gravity and that there is a fixed period of gravi-responsiveness from the fern spore. The bioCD technology is intended for the NASA SporeSat mission, an autonomous free-flying 3U spacecraft unit that utilizes flight-proven technologies of previous nanosatellite missions.

Biography

Wan W. Amani Wan Salim received her B.Sc. (2001) and M.Sc. (2003) degrees in Electrical Engineering from the University of Minnesota and her Ph.D. (2009) in Biomedical Engineering from Purdue University. In 2009, she joined the School of Engineering Education at Purdue University as a Postdoctoral Researcher and was appointed as a Faculty Fellow. In 2011, she joined the Department of Agricultural and Biological Engineering, also at Purdue University, as a Postdoctoral Researcher in the field of micro/nanofabrication and biosensing. Her current research interests are the design and development of micro-electro-chemical sensors for applications in astrobiology, biomedicine, and agriculture. She is currently the Principal Investigator for a NASA-funded nanosatellite mission called SporeSat.

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