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# Activation of ERK Pathways using Alternative Current Electric Fields

The extracellular-signal-regulated kinase (ERK) pathway is a major component of the MAPK signaling pathway, and its activation plays an important role in cell growth, proliferation, differentiation and apoptosis. Thus, dysfunction in the ERK pathway may contribute to numerous diseases including cancer, diabetes, inflammation, autoimmunity and so on. Controlling ERK activation in a synchronized manner could be a powerful tool in basic research, drug discovery, as well as clinical use. Current approaches for clinical ERK activation utilize optogenetics or pulsed stimulation with epidermal growth factor which are neither practical nor precise.

Researchers at the Biodesign Institute of Arizona State University and colleagues at UC Davis have developed novel methods of modulating the ERK pathway using alternative current (AC) electric fields (EFs). Patterned local microelectrodes that emit these AC EFs within a specific frequency range, can reproducibly activate the ERK pathway independent of Faradaic process and at a single-cell resolution. These microelectrodes can be utilized in research or clinical tools to precisely control, synchronize and modulate the amplitude and frequency of ERK activation. In clinical applications, these methods do not require repeated addition and washout of chemicals or genetic modification of cells.

The ability to modulate both the amplitude and frequency of ERK activation could be a powerful new platform for regulating cell behaviors in a multitude of disease states.

Potential Applications

- Research
- Drug discovery
- Clinical – activation of ERK pathway
  - Cancer
  - Wound healing/vascular tissue regeneration
  - Diabetes

- Autoimmunity
- Chronic inflammatory diseases
- Huntington’s disease

Benefits and Advantages

- High degree of spatial resolution and control for pathway activation
- Specific for ERK-signaling pathways
- Frequency could be tuned to selectively activate other signaling pathways
- Can be repeatedly activated
- Does not require chemicals or genetic modification of cells

For more information about this opportunity, please see

Qing et al - APS Meeting 2019

For more information about the inventor(s) and their research, please see

Dr. Qing's departmental webpage

Dr. Qing's laboratory webpage