A Novel Method of Reverse Electrowetting Utilizing Self-Induced Potential with Direct Applications in Energy Harvesting

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The number of wearable and implantable devices (WIDs) used is projected to reach 515 million by 2017. A major limitation with many WIDs is the need for expensive and cumbersome battery replacement procedures. A device utilizing reverse electrowetting (RE), a process that converts mechanical compressions of liquid droplets into electrical energy, can potentially replace limited-lifetime batteries and sustainably power WIDs. However, the need for an external voltage source limits the applicability of the existing RE method, preventing it from scaling down to small devices. This paper documents the development of a new RE method that utilizes a self-induced electrochemical voltage of 1.04V, eliminating the need for an external source of potential. Instantaneous charge, energy, current, and power graphs, as well as other results, strongly support that our RE method works without an external voltage source and produces a quantifiable energy density. Our method is also down-scalable and is 145% more cost-efficient, safer, and easier to fabricate than the state-of-the-art RE method. In addition, our RE technique generates energy from plain water instead of the liquid metals used in the existing RE method. Our method can be incorporated directly into powering WIDs, such as fueling pacemakers from heartbeats, and has laid the foundation for continuously powering small-scale devices by capturing energy from ambient motions.

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