3D Printed Polymer Based Flexible Electrodes for Reverse Electrowetting on Dielectric Energy Harvesting

Pashupati. R. Adhikari[a], Nurul Md Islam[a], Yijjie Jiang[a], Russell C. Reid[b], Ifana Mahbub[c]

[a]Department of Mechanical Engineering, University of North Texas, Denton TX 76207

[b]Department of Engineering, Dixie State University, St. George, UT 84770

[c]Department of Electrical Engineering, University of North Texas, Denton, TX 76201

Abstract

In this work, we present three-dimensional (3D) printed polymer-based flexible electrode substrates that exhibit high surface area and flexibility in reverse electrowetting-on-dielectric (REWOD) energy harvesting for powering patchable human health monitoring sensors. Composite electrode substrates are printed using polydimethylsiloxane (PDMS) polymer and carbon black (CB) in 20:1 ratio by weight to provide some mechanical strength to the electrodes. Thin film layers (~250 nm each) of titanium (Ti) for current collection and aluminum oxide (Al_2O_3) as dielectric are deposited on the substrates to complete the electrode fabrication process. Without applying any bias voltage, the AC current due to periodic variance in capacitance resulting from mechanical modulation of an electrolyte droplet between two electrodes is measured for a frequency range that falls within human motion activities such as walking and running. Mechanical integrity of the electrodes are characterized in terms of stress-strain analysis demonstrating robustness of the electrodes for their longevity.