Thread Based Sensors and Interconnects for Medical Diagnostics

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Abstract

Threads, traditionally used in the apparel industry, have recently emerged as a promising medium for flexible electronics, microfluidics and physical and chemical sensors. These same threads provide inherent flexible interconnects between sensors, microfluidics and readout electronics, eliminating the need for more advanced packaging technologies in thread-based devices. Standard sewing methods allow for easy integration of these devices with their target environment.

We have demonstrated a tool-kit of threads capable of physical and chemical biosensing and drug delivery. The sensors are fabricated using inexpensive, clean-room free processes using various nanomaterials and hydrogels and are connected to electronic circuitry using thread-based flexible interconnects for readout, signal conditioning, and wireless transmission. Here we exhibit threads capable of in vitro and in vivo strain measurement, gastric pH measurement and on-demand drug delivery with integrated fluidic channels.

Threads are functionalized using carbon nanotubes, polyaniline, commercially available conductive inks and a PEGDA/alginate heat-sensitive hydrogel. The resulting strain sensors exhibit a gauge factor of 3 and pH measurement shows a sensitivity of -59.6 mV/pH. On-demand drug delivery is completed for healing of diabetic ulcers.