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Soft Microtubular Sensors for Biomedical Applications

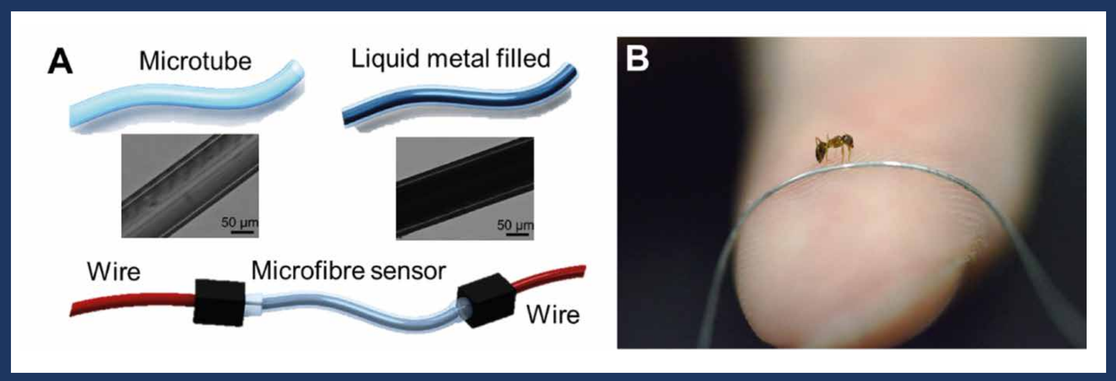

Figure 1. Design of the microtubular sensor. (A) The microtubular sensor consists of a liquid metal core enclosed in an elastomeric microtube. (B) The microtubular sensor is smaller than an ant and can conform to curvilinear surfaces such as fingertips perfectly.

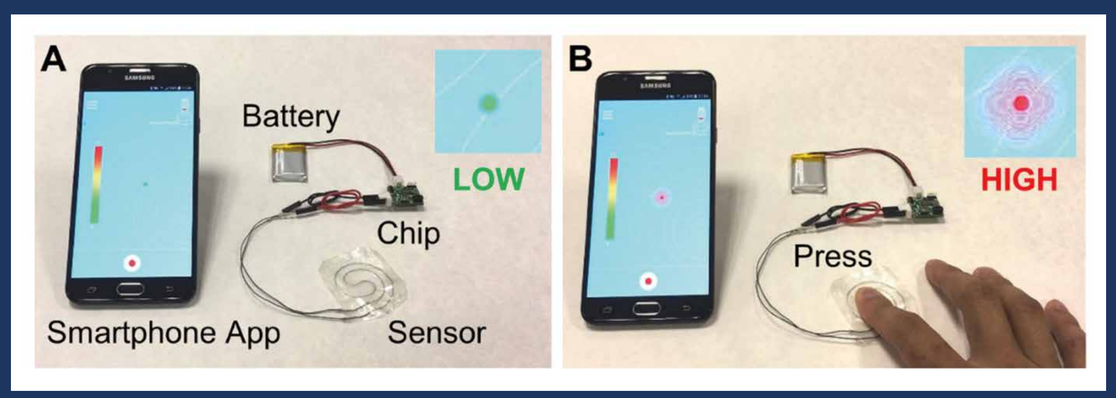

Figure 2. Wireless monitoring system prototype. (A) Microtubular sensor is connected to a PCB chip to transmit real-time reading to a smartphone. (B) App changes color indicator depending on pressure intensity.

Value Proposition

We developed a flexible, stretchable, wearable, and washable piezoresistive microtubular sensor that is highly sensitive to mechanical perturbations. Its tiny footprint is approximately a cross-section of a strand of hair, which is one of the smallest in the existing technologies. This enables users to apply the sensor almost indistinguishably, thereby improving compliance and comfort. Furthermore, the tubular structure allows conformability over 3D curvatures, which cannot be achieved with planar substrates. (Figure 1 and 2)

What Can This Technology Do For Your Business?

For commercialization, we intend to spin off the technology with our start-up Microtube Technologies, focusing on wearable sensors. The wearable microtubular sensors can find huge market in healthcare devices, robotics, and consumer electronics. Examples of applications are pulse and blood pressure monitoring for cardiovascular diseases, pressure monitoring for compression therapy and diabetic foot, rigidity assessment for erectile dysfunction, etc. (Figure 3 and 4)

Meanwhile, we intend to license the process of making the microtubes to another company for mass production. This would provide support for other applications including cell separation, microrobotics, and chemical sensing for many other applications in biomedical engineering, personalized medicine, environmental engineering and food industry. (Figure 5)

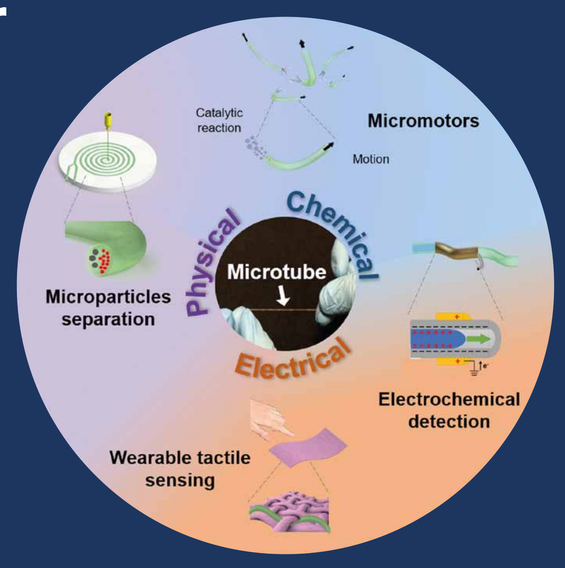

Figure 5. Applications of soft microtubes. Schematic showing the diverse applications of the microtubes in various domains: from microparticles/cells separation and droplet generation using physical force fields, to micromotor actuation using biocatalytic reactions, to triboelectric sensing using electrochemical principles, and finally to wearable sensing using physicoelectrical phenomenon.

Potential Applications

We aim to use this versatile and imperceptible fiber-like wearable sensor and explore its applications in biomedical engineering, to address various clinical needs, including pressure monitoring for compression bandaging, continuous blood pressure measurement, monitoring circulation of blood vessels during surgery, rigidity assessment of erectile dysfunction, etc. (Figure 3 and 4)

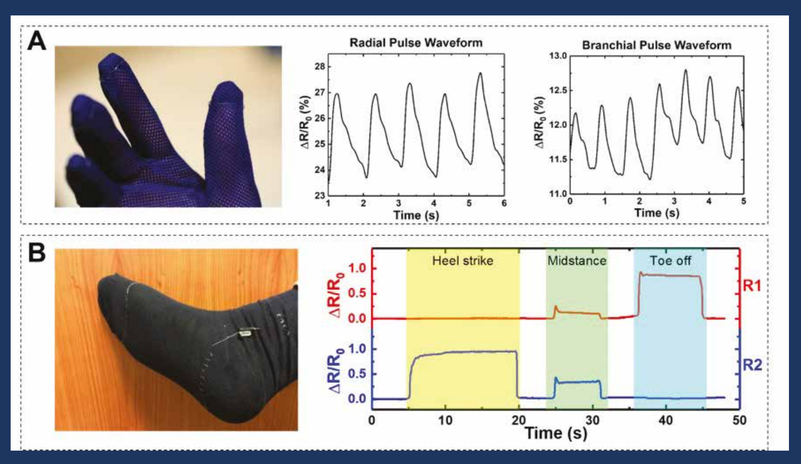

Figure 3. Wearable microtubular sensors woven onto (A) a fabric glove for arterial pulse monitoring and (B) a sock for foot pressure monitoring.

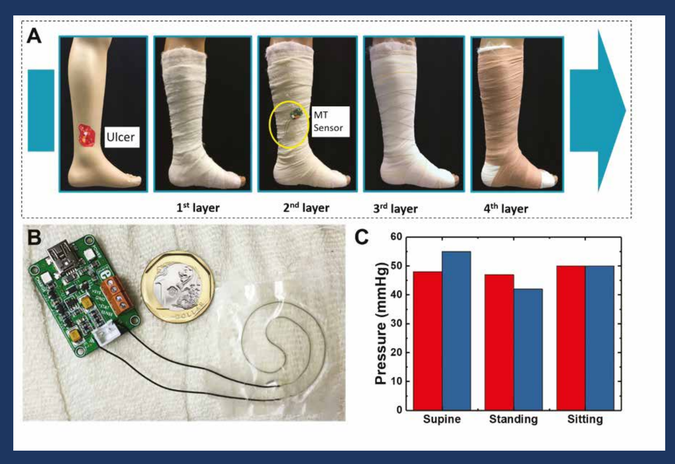

Figure 4. Spiral microtubular sensor for compression therapy. (A) Integration with compression bandaging for treatment of venous leg ulcer. (B) Wireless sensor system including a coin-size sensor and an integrated circuit chip. (C) Intra-layer bandage pressure monitoring at three different postures, supine, standing and sitting. Red bars show reading from commercial device and blow bars show reading from microtubular sensor.

For more information on the technology, contact:

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