Wearable microtubular sensor for pulse monitoring

Yu Longteng[1], Xi Wang[2], Yeo Joo Chuan[1], Lim Chwee Teck[1,2,*]

1. Department of Biomedical Engineering, National University of Singapore, Singapore 117583
2. Centre for Advanced 2D Materials and Graphene Research Centre, National University of Singapore, Singapore 117542

* E-mail: ctlim@nus.edu.sg

Abstract

Real-time arterial pulse monitoring facilitates early detection of diseases and disorders of human heart and vascular system, and can improve patient survival rate and reduces healthcare costs. However, current pulse monitoring devices are cumbersome and fail to conform to the skin perfectly. In contrast, wearable devices can enable point-of-care health monitoring and provide advantages such as unobtrusiveness, compact size, and light weight. In this presentation, a soft microtubular sensor as small as a strand of hair is proposed as a fast, low cost, reliable and imperceptible human pulse monitoring solution. This microtubular sensor features a unique architecture comprising a liquid-state conductive element (eGaIn) core and an ultrathin silicone elastomer microtube, which responds to subtle epidermal pressure perturbations based on sensor resistance change. Its performance, such as sensitivity, durability and wearability, is investigated. The microtubular sensor can distinguish forces as small as 5 mN and possesses a high force sensitivity of 68 N^{-1}, and can withstand cyclical compressive loading. Brachial and radial arterial pulse waves are continuously monitored with high fidelity using the microtubular sensor. The microtubular sensor showed that, compared to the rest state, radial pulse rate and pressure after exercise increased by a factor of ~1.25 and ~1.5, respectively. The outcome of the proposed sensor demonstrates great potential in developing wearable devices for point of care health monitoring.