

Abstract

# Chitosan-Based Piezoelectric Flexible and Wearable Patch for Sensing Physiological Strain †

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**Abstract:** Innovative biocompatible organic materials with piezoelectric properties have a great potential for the development of wearable sensors for monitoring physiological parameters. Among them, Chitosan (CS) is a natural, biodegradable, antibacterial and low cost biopolymer that shows an interesting piezoelectric behaviour. In this context, this work reports on a protocol where plain chitosan films (CS-F) are exploited to easily create a piezoelectric flexible wearable patch. By adapting a simple drop casting method reported in, we here demonstrate that a 70 µm thick CS-F can exhibit good piezoelectric properties. The structure of CS-F was analysed thanks to XRD technique: the spectrum reveals peaks of partially crystalline chitosan film, indicating presence of organized polymeric chains. Piezoresponse Force Microscopy scans confirmed the presence of domains with opposite polarization directions with an extrapolated value of piezoelectric coefficient  $d_{33}$  of 2.54 pC/N. A microfabrication process for patch realization has been set up. The top electrode was created by simple thermal evaporation of gold directly onto the free-standing CS-F. This bilayer was then precisely cutted using a cutting plotter and assembled on the copper bottom electrode. The complete patch can be conformally applied on the skin. The ability of the device to sense physiological movements was validated by an ad hoc measurement set up generating strain pulses; open circuit voltage peaks up to 20 mV were detected. This sensor represents an important step towards totally biocompatible and biodegradable wearable devices.

**Keywords:** chitosan; organic; piezoelectric; film; sensor; patch; flexible