engineering proceedings

MDPI

Abstract

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

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† Presented at the 8th International Symposium on Sensor Science, 17–28 May 2021; Available online: https://i3s2021dresden.sciforum.net/.
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Abstract: Innovative biocompatible organic materials with piezoelectric properties have 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 interesting piezoelectric behaviour. In this context, this work reports on a protocol where plain chitosan films (CS-F) are exploited to easily create a flexible, wearable piezoelectric patch. By adapting a previously reported simple drop casting method, we here demonstrate that a 70 µm thick CS-F can exhibit good piezoelectric properties. The structure of CS-F was analysed via the XRD technique: the spectrum reveals peaks of partially crystalline chitosan film, indicating the presence of organized polymeric chains (Suppl. Ppt. Slide 8). Piezoresponse Force Microscopy scans confirmed the presence of domains with opposite polarization directions with an extrapolated value of the 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 the simple thermal evaporation of gold directly onto the free-standing CS-F (Suppl. Ppt. Slide 10). This bilayer was then precisely cut using a cutting plotter and assembled on the copper bottom electrode (Suppl. Ppt. Slide 11). 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 (Suppl. Ppt. Slide 13). This sensor represents an important step towards totally biocompatible and biodegradable wearable devices.

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

Citation: de Marzo, G.; Desmaële, D.; Algieri, L.; Natta, L.; Guido, F.; Mastronardi, V.; Mariello, M.; Todaro, M.T.; Rizzi, F.; De Vittorio, M. Chitosan-Based Piezoelectric Flexible and Wearable Patch for Sensing Physiological Strain. *Eng. Proc.* **2021**, *6*, 12. https://doi.org/10.3390/I3S2021Dresden-10124

Academic Editors: Gianaurelio Cuniberti and Larysa Baraban

Published: 17 May 2021

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/I3S2021Dresden-10124/s1, Poster S1: i3s_S5_10124_Chitosan_Based_Piezoelectric_F_powerpoint.

Author Contributions: G.d.M., D.D. and M.D.V. conceived the project; F.R. and M.D.V. supervised the research; G.d.M. optimized films fabrication; D.D. and G.d.M. designed the sensor; G.d.M. and D.D. fabricated the sensor; G.d.M. and L.A. performed PFM measurments; F.G. performed SEM imaging and drew device's scheme ; L.N., F.G. and V.M. designed and developed measurement set up; M.M. performed optical images; M.T.T. supported state of art research and methodology

definition; G.d.M. wrote the manuscript with contribution and reviewing of all authors. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: We kindly thank Donato Cannoletta for performing XRD measurements.

Conflicts of Interest: The authors declare no conflict of interest.