List of Responses and Revisions

Title: "Strain-Insensitive Elastic Surface Electromyographic (sEMG) Electrode for Efficient Recognition of Exercise Intensities"

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We would like to thank the editor for giving us a chance to resubmit the paper, and also thank all the reviewers for their time, constructive comments and useful suggestions. To clearly address the amendments performed in the revised manuscript, we have quoted the specific reviewers' comments in our responses correspondingly. All changes to the original version of the document are highlighted to facilitate the review process.

Response to Reviewers' Comments

Reviewer #1

Reviewer #1's general comment:

The authors presented a fabrication method for strain-insensitive elastic electrode. The presented results are valuable.

Response:

We thank the reviewer for his/her positive comments on our work. We have carefully checked all the reviewers' comments and revised the manuscript accordingly.

Reviewer #1's comment 1:

However, it is suggested that the supplementary materials should not be included in main texts (e.g. figure S1, figure S2a, figure S4 and their descriptions). If necessary, the authors should put these results into main texts and make some rearrangements.

Response:

We thank the reviewer for reminding us to provide specific experimental discussion.

Following the reviewer's advice, we have added the mentioned results into the main text. Please see Figure 2 and 3. Accordingly, we have adjusted the relevant decription.

In these steps, the mass ratios of MPs and PDMS are an important parameter to decide the electrical property of the bottom layer. Therefore, we had studied the effect of this mass ratio parameter on the resistivity of the bottom layer. The results are shown in Figure 2b. The longitudinal resistivity decreases significantly with the increase of mass ratios (i.e., MPs concentration). When the mass ratio reaches 1:1, the longitudinal resistivity tends to be stable and thereby the optimum technology parameter is confirmed as 1:1 mass ratio to prepare the bottom layer. According to the four probes testing result of resistance profile (shown in Figure 2c), the surface resistivity of the 3-layered electrode is lower than 0.2 mΩ/sq, which indicates its high electrical conductivity.

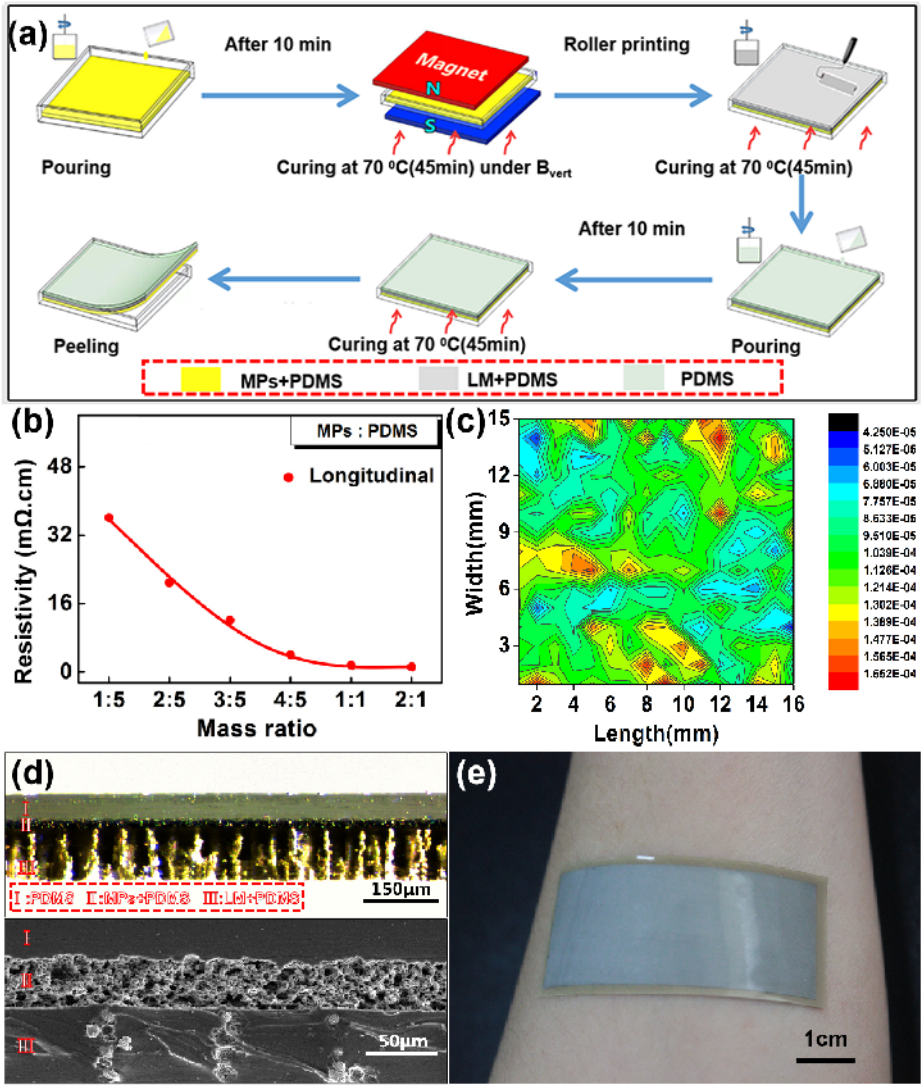


Figure 2. Fabrication of 3-layered elastic sEMG electrode: **(a)** Schematic illustration for the fabrication of elastic sEMG electrode. **(b)** Change in longitudinal resistivity of bottom layer (MPs +PDMS) under different mass ratios. **(c)** The mapping images of surface resistivity of elastic electrode. **(d)** The cross-sectional images of electrode: optical microscope image (top), and SEM image (bottom). **(e)** The photograph of electrode sample conformed to skin.

Electrodes elongation at break is found to be 144.48% (Figure S3), which confirms the high elasticity of our electrode. As skin strain generally remains less than 30%, we have electro-mechanically characterized our electrode at 10%, 20%, and 30%. The electro-mechanical characterization of the elastic electrode is presented in Figure 3. When the electrode is mechanically strained, it has shown good tensile recovery during the loading-unloading process, indicating small hysteresis (Figure 3a-b). The gauge factors (GF) of our electrode in transverse direction and longitudinal direction are -0.234, and 0.265, respectively. This confirms the good strain-insensitivity of our electrode. The GF is defined as the ratio of resistance change ($\Delta R/R_0$) to the applied stretching strain. To evaluate the fatigue resistance, a cyclic stretching test was performed on the electrode, at a strain of 30%. Figure 3c shows that our electrode maintained its GF without any significant deterioration even when stretched up to 1500 cycles. The average GF in transverse direction and longitudinal direction are -0.252, and 0.269, respectively, which proves that our electrode is highly resistant to mechanical fatigue.

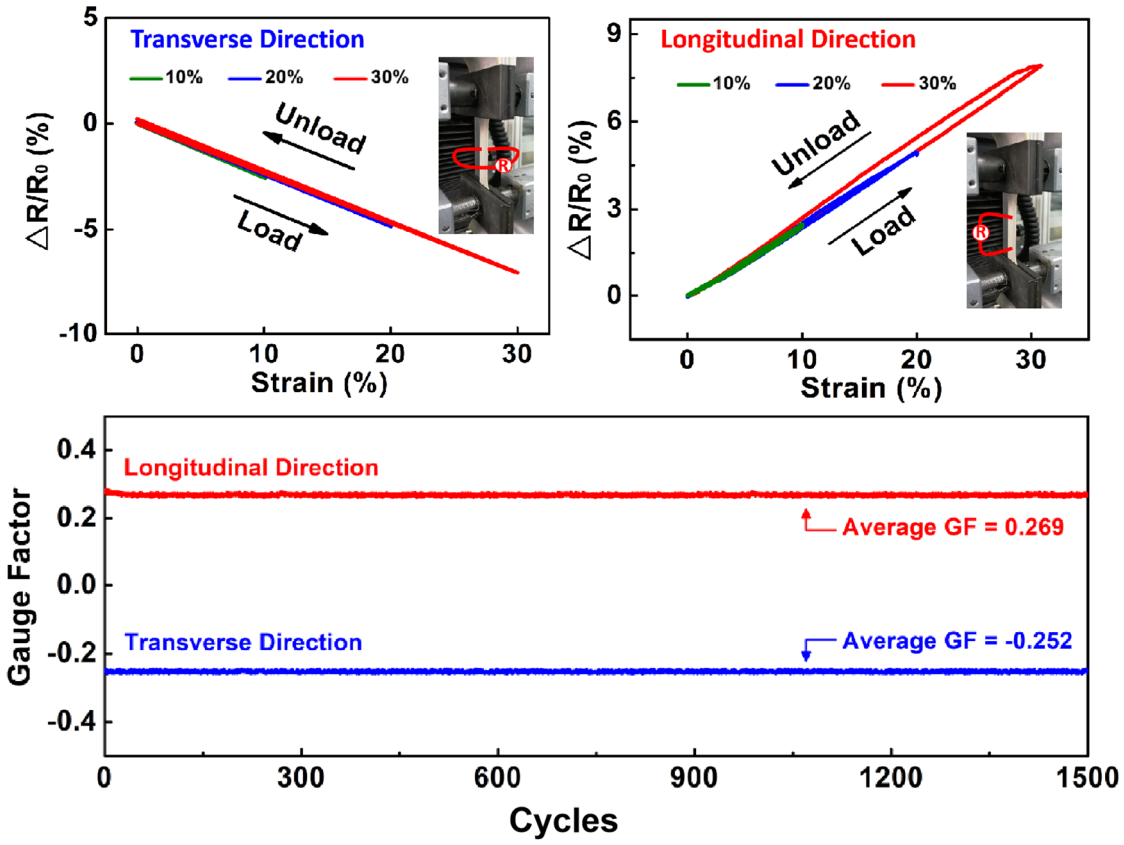


Figure 3. Electro-mechanical characterization of 3-layered sEMG electrode. Resistance in different directions as a function of the loading-unloading of various strains: **(a)** transverse resistivity, and **(b)** longitudinal resistivity. **(c)** Gauge factors as a function of stretching cycle. The stretching strain is 30%.