# 3D PRINTING OF PEDOT:PSS CONDUCTIVE POLYMER BY DIGITAL LIGHT PROCESSING FOR APPLICATION IN BIOELECTRONICS


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## INTRODUCTION

Conducting polymers (CPs) such as poly(3,4-ethylenedioxythiophene):polystyrene sulfonate (PEDOT:PSS), polypyrrole (PPy) or polyaniline (PANi), are very good candidates as bioelectronic or energy devices, i.e., electrodes, biosensors, electronic skin or soft robotics due to their biocompatibility and good electrical conductivity. However, the majority of the current devices made of PEDOT thin films are rigid, two-dimensional systems and possess uncontrollable geometries and architectures that lead to poor mechanical and electronic/ionic properties.[1,2] These drawbacks can be overcome by additive manufacturing (AM) of CPs, where 3D printing has emerged as a powerful tool for the design and fabrication of electronic devices in the last years. However, CPs do not show the typical mechanical properties and ease of processing of thermoplastic polymers such as polyethylene. In addition to this, they are insoluble in water and infusible, which makes their 3D printing processability a challenge. To solve this problem, we have design a conductive ink based on PEDOT:PSS which has been photocured by digital light processing (DLP) method in order to create flexible electrodes for electrocardiography (ECG) recordings.

## 3D PRINTING METHOD

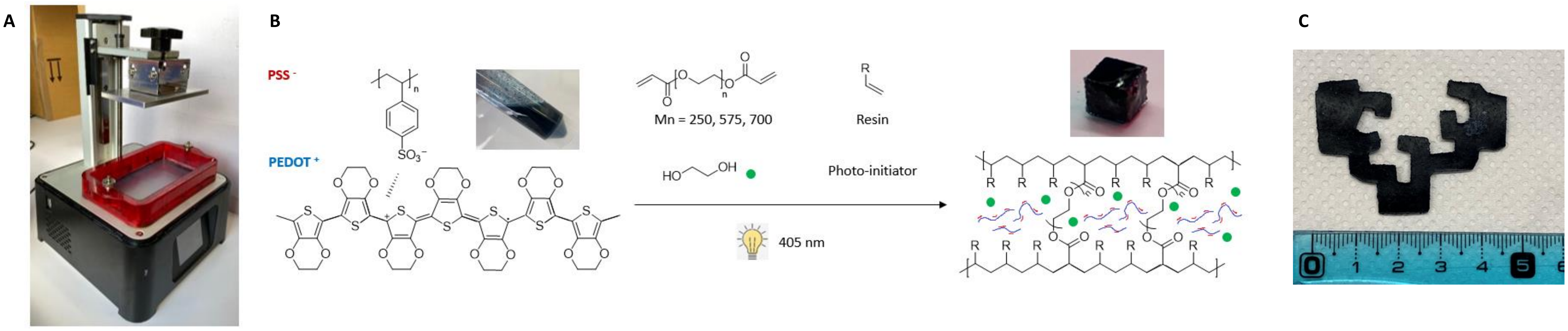


*Figure 1*. **A)** Phrozen Sonic Mini 3D printer. **B)** Scheme of the synthesis of conductive hydrogels. **C)** UPV/EHU logo printed by DLP.

## RESULTS AND DISCUSSION

- Photopolymerization Reaction Kinetics and Gel Point

Results reveal that all the samples reach full conversion within 15 seconds, which demonstrates that this reaction is very fast and can be used for 3D printing (some dental resins take minutes to photocure).

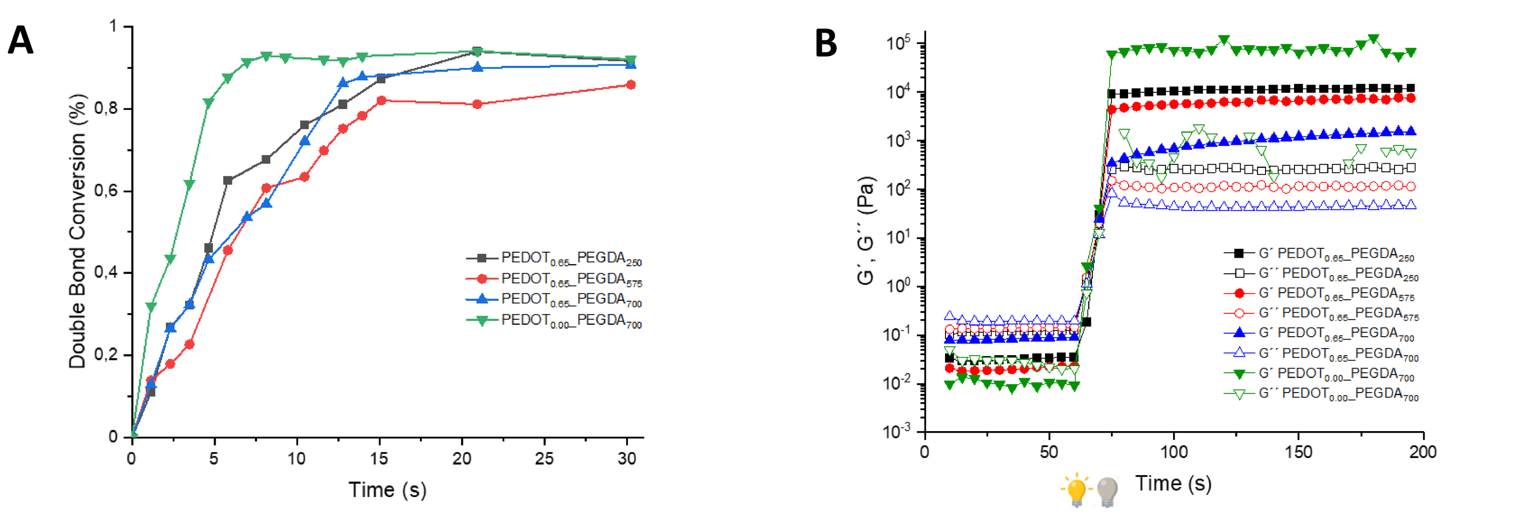


*Figure 2*. **A)** Kinetics of photopolymerization. **B)** Rheological characterization of the gel point.

- Resolution test

As the molecular weight of the used poly(ethylene glycol) diacrylate (PEGDA) polymer increases, the resolution of the printed pieces is better. This behaviour seems to be more closely correlated with PEGDA molecular weight than acrylate concentration.

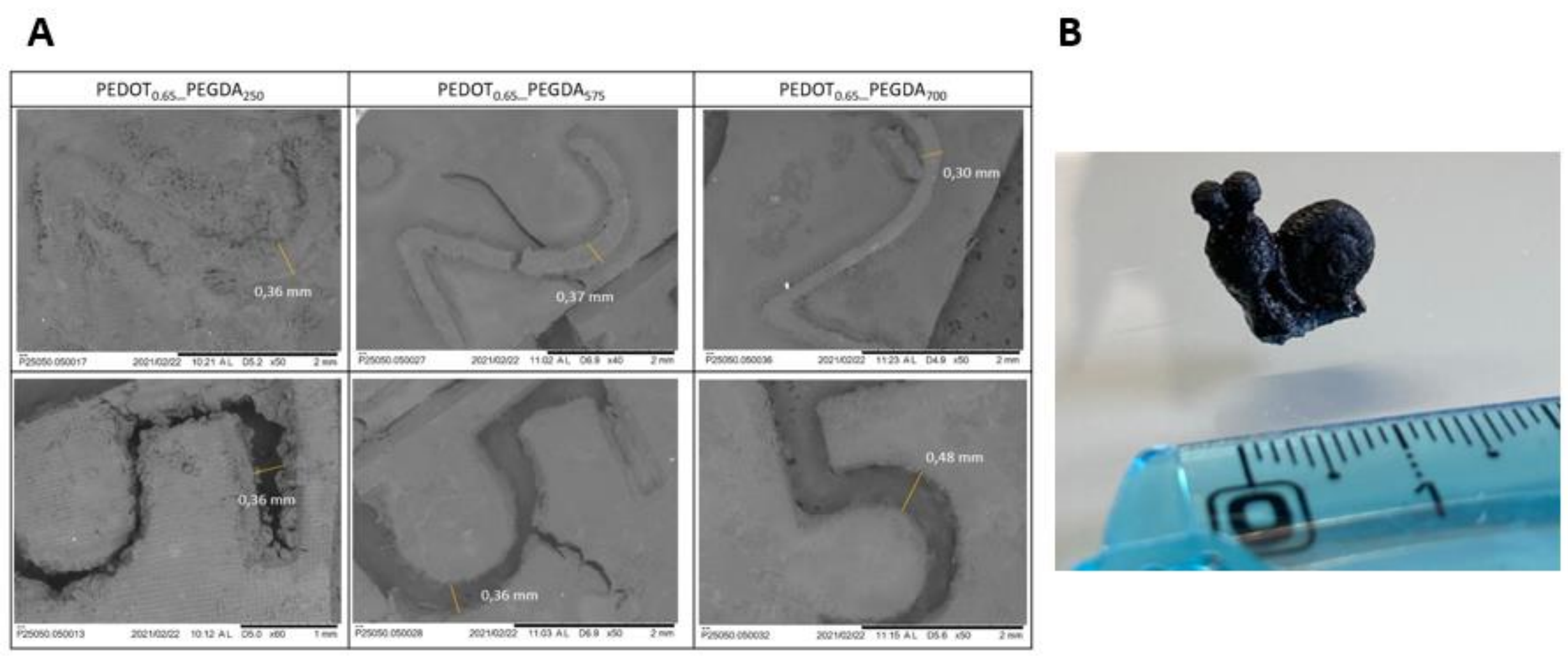


*Figure 3*. **A)** SEM images of different printed samples. **B)** A snail printed by DLP.

- Mechanical and electrical properties

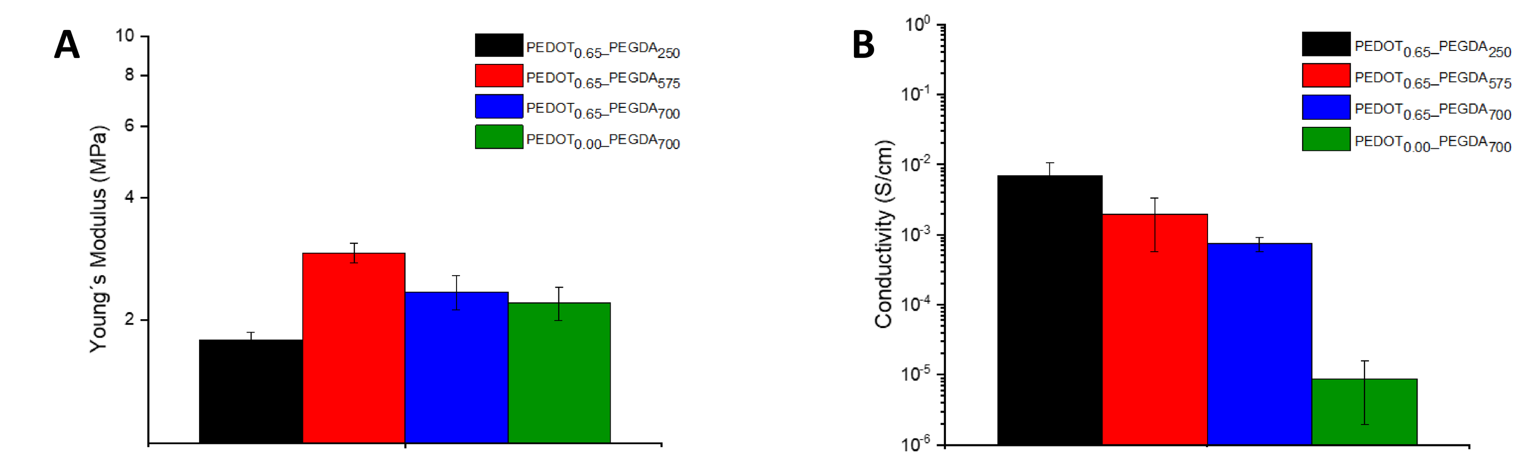


*Figure 4*. **A)** Young´s Modulus values of different samples. **B)** Electrical conductivity of the synthetized hydrogels.

- ECG recordings

These hydrogels have been used as electrodes for electrocardiography (ECG) recordings, whose signals are comparable to those of medical electrodes.

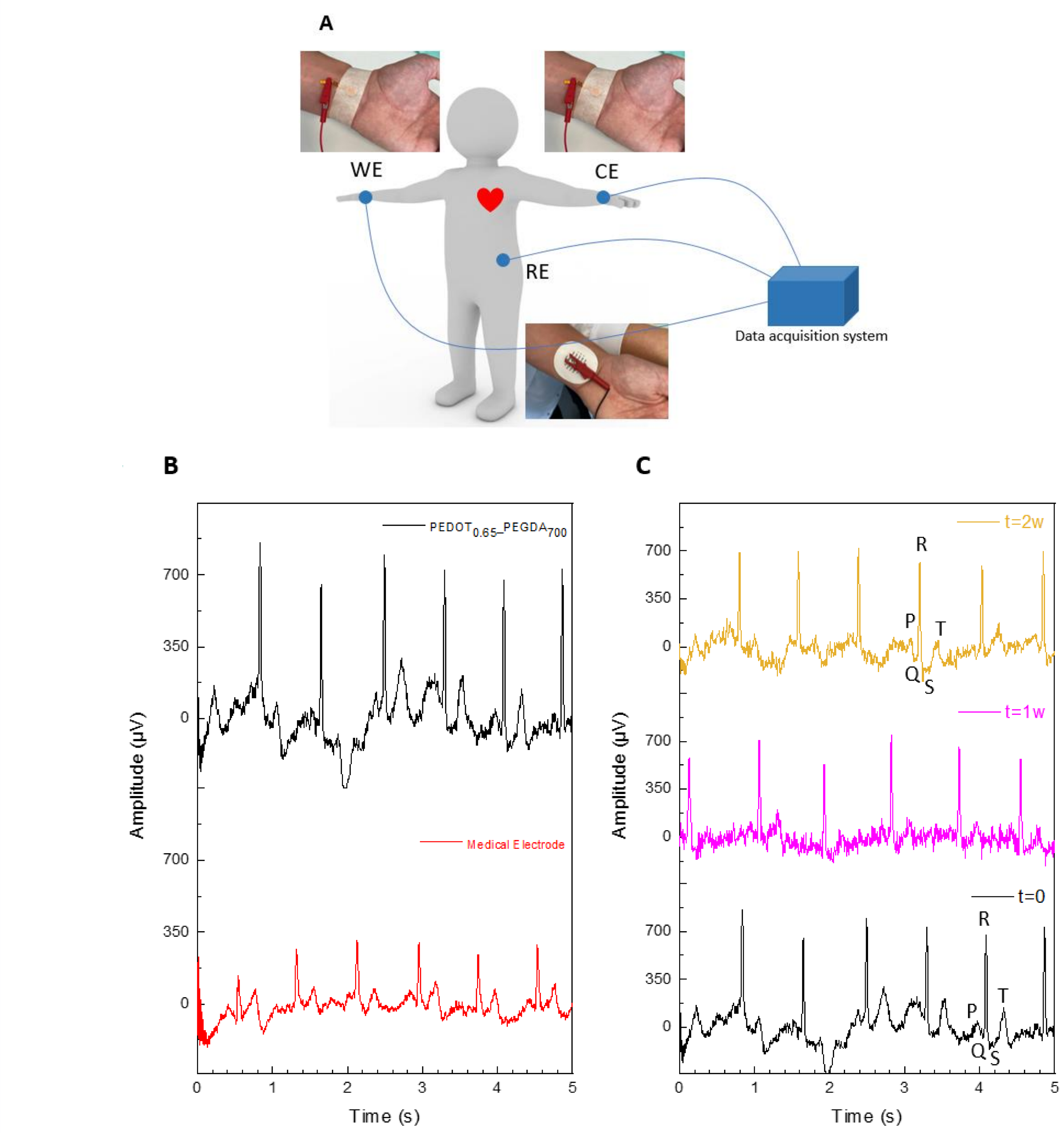


*Figure 5*. **A)** Scheme of ECG performed. **B)** ECG performed with medical electrode and synthetized hydrogel. **C)** ECG performed with synthetized hydrogel over time.

## CONCLUSIONS

PEDOT based materials have been synthetized by DLP method with great resolution, high electrical conductivity and good mechanical properties. Moreover, these materials have been used as electrodes for successful ECG recordings.

## ACKNOWLEDGEMENTS


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