

4D Printable Electroactive and Biodegradable PEDOT:κ-Carrageenan inks for (Bio)electronics

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1. INTRODUCTION & OBJECTIVE



Traumatic brain injury (TBI)

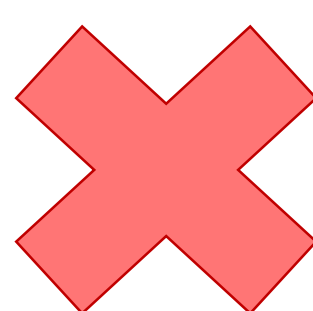
- Major cause of deaths
- 55 million cases every single year
- 400 billion \$ annually

Measuring Intracranial Pressure (ICP) is crucial

TRADITIONAL ELECTRODES

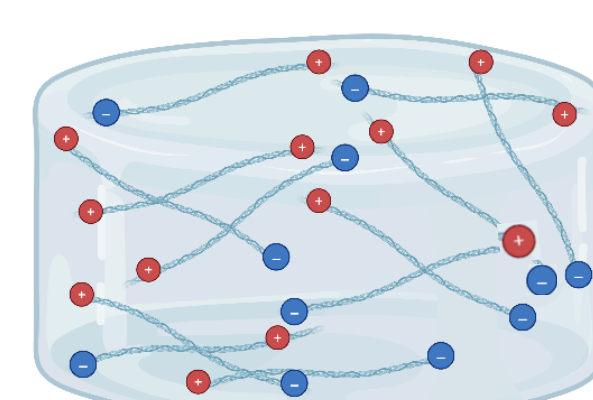


- Expensive
- Two times of surgical procedure
- Restricts patient mobility
- Create a lot of surgical waste
- Toxic, etc.



OUR WORK

Development of minimally invasive electrodes

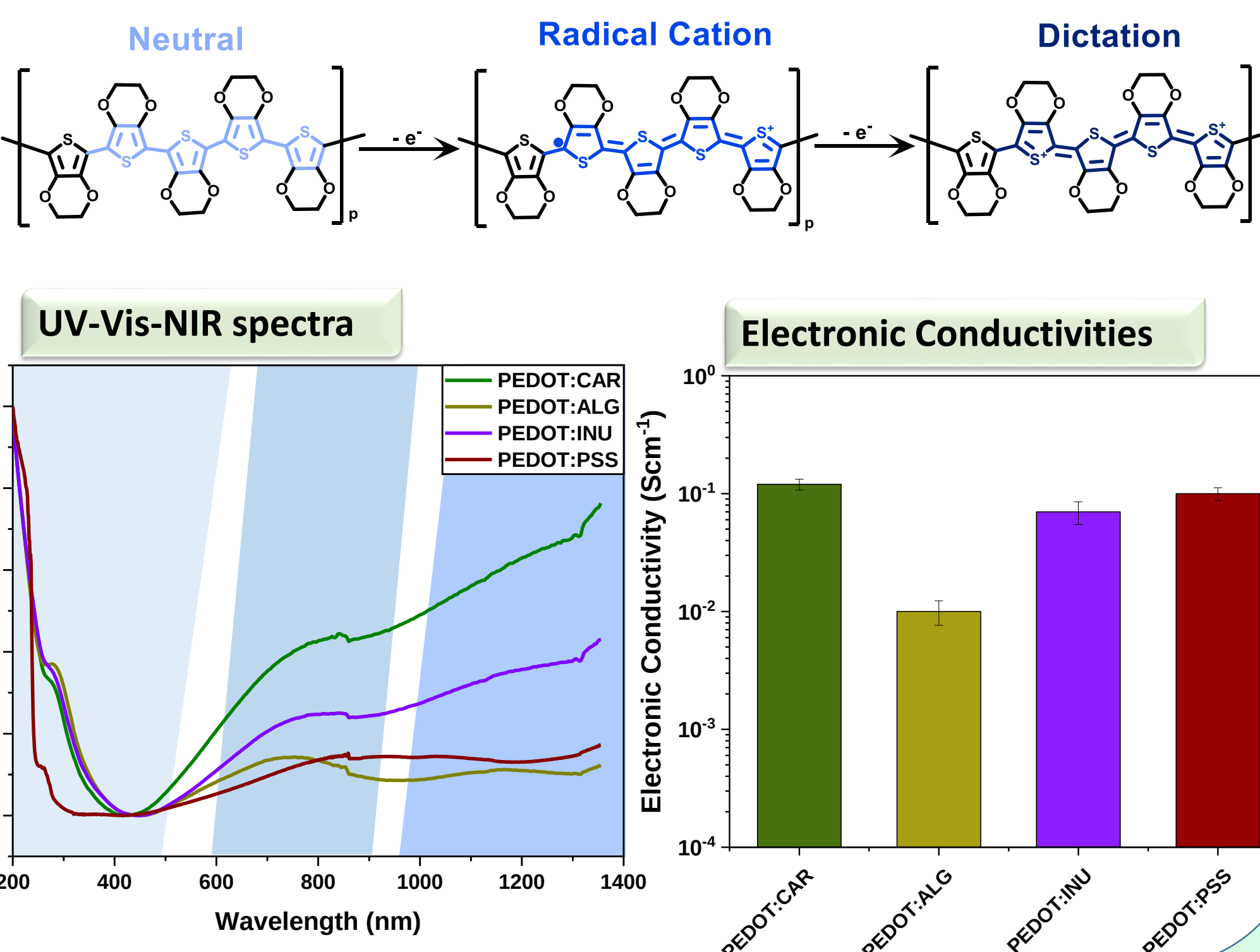
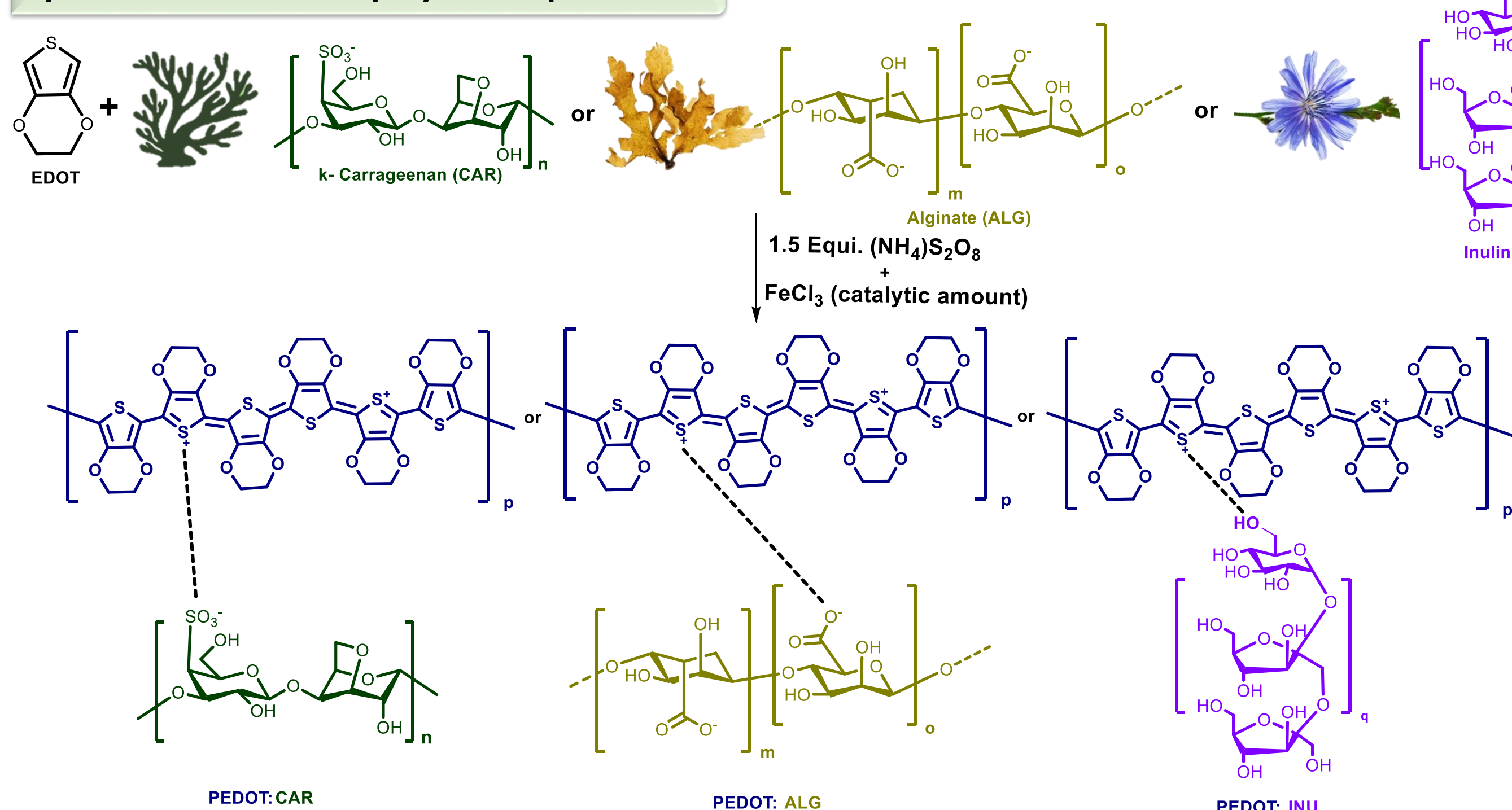


- Inexpensive
- Degradable
- Biocompatible
- No surgical waste
- Sustainable, etc.



2. SYNTHESIS & CHARACTERISATION OF PEDOT:BIOPOLYMER DISPERSIONS

Synthesis of PEDOT:Biopolymer dispersions



3. ADDITIVE MANUFACTURING & CHARACTERISATION OF PEDOT:CAR HYDROGELS

3D-DLP of PEDOT:CAR inks

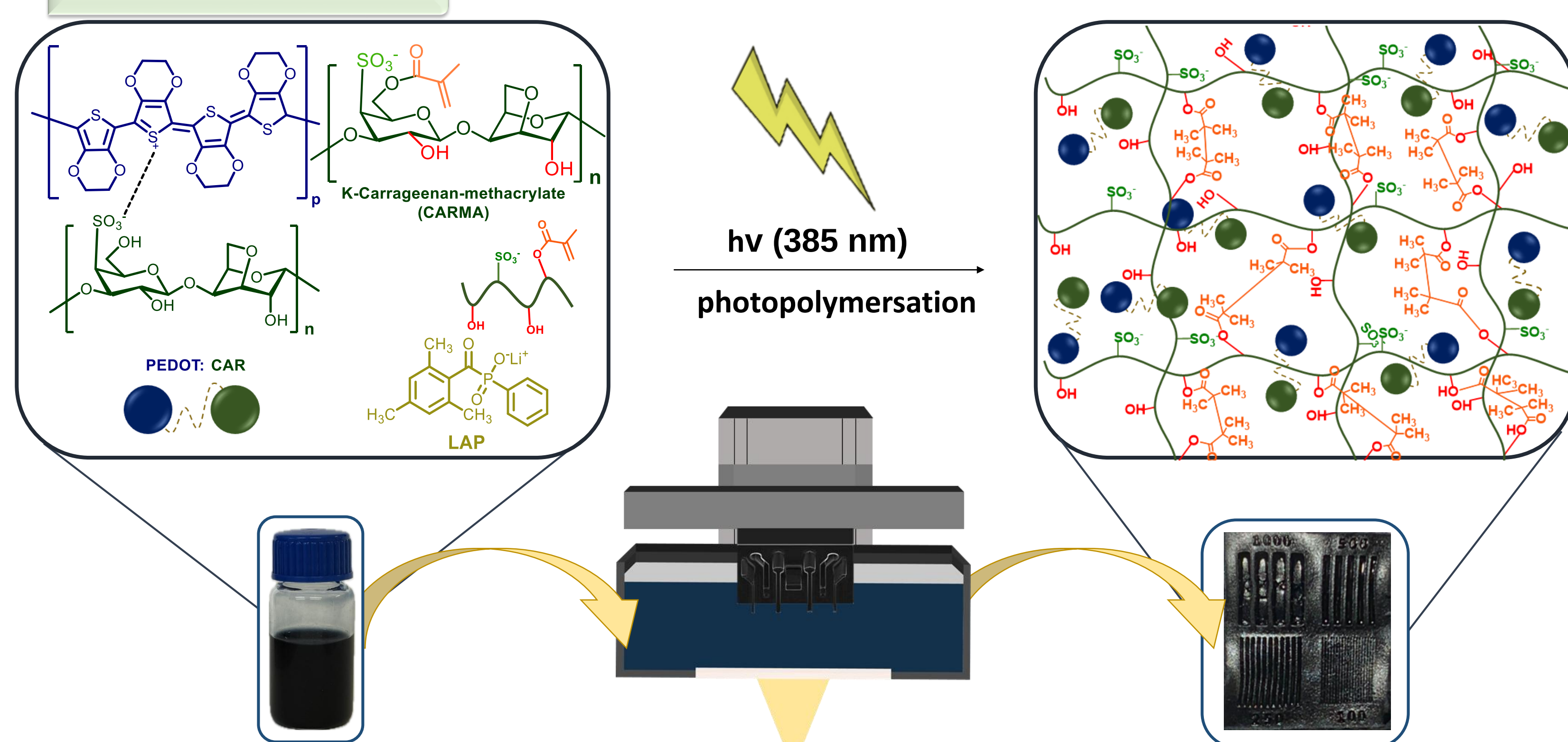
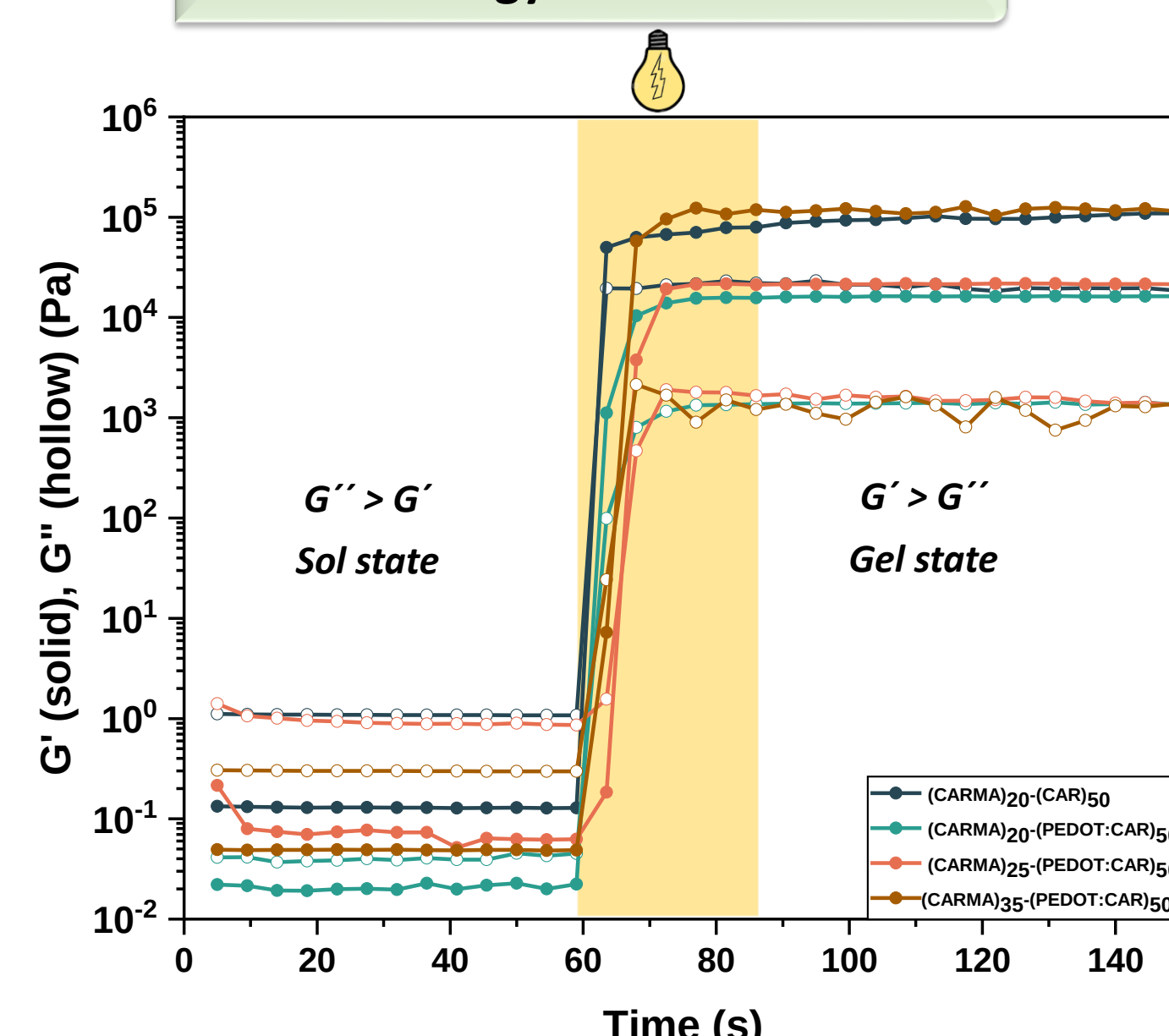
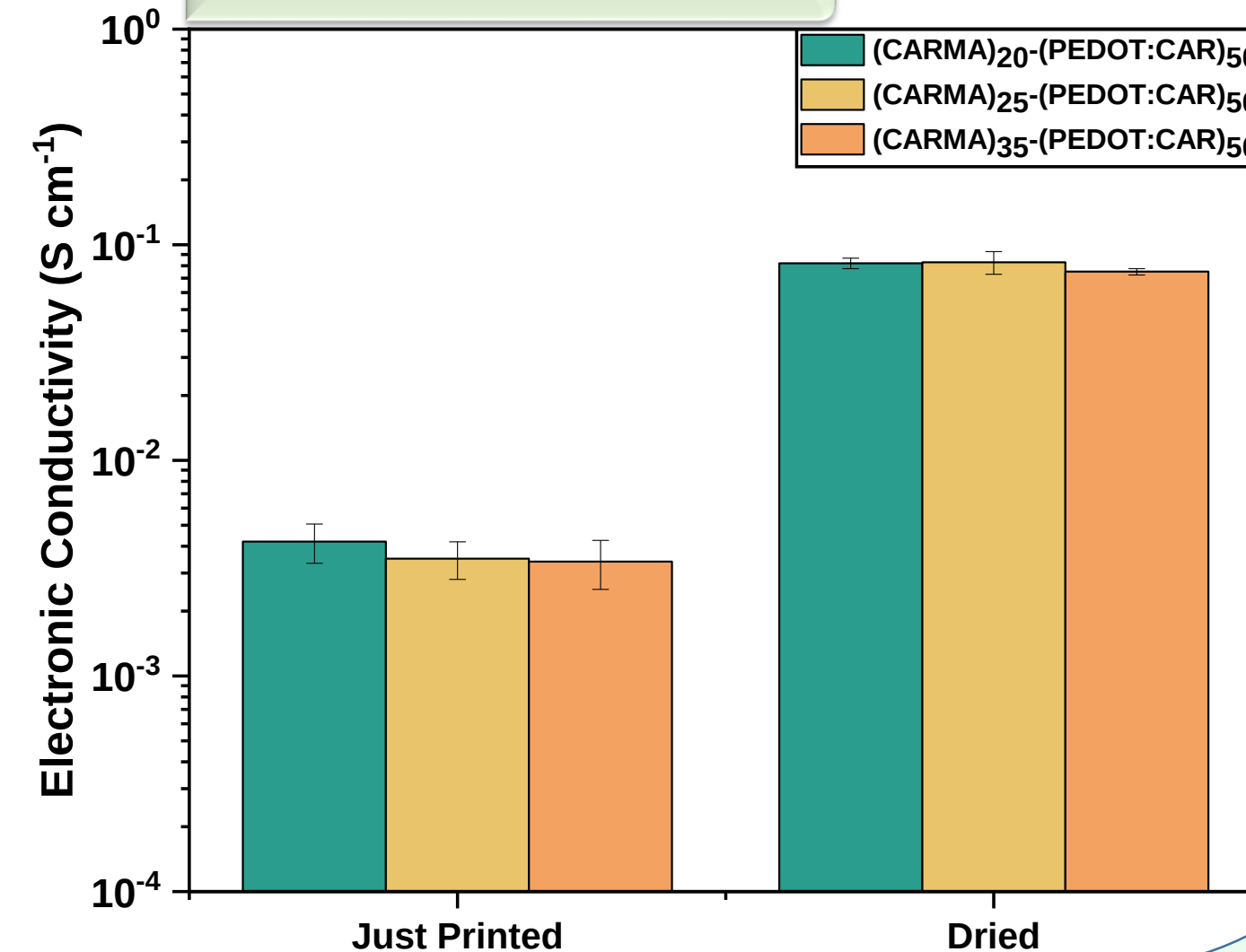


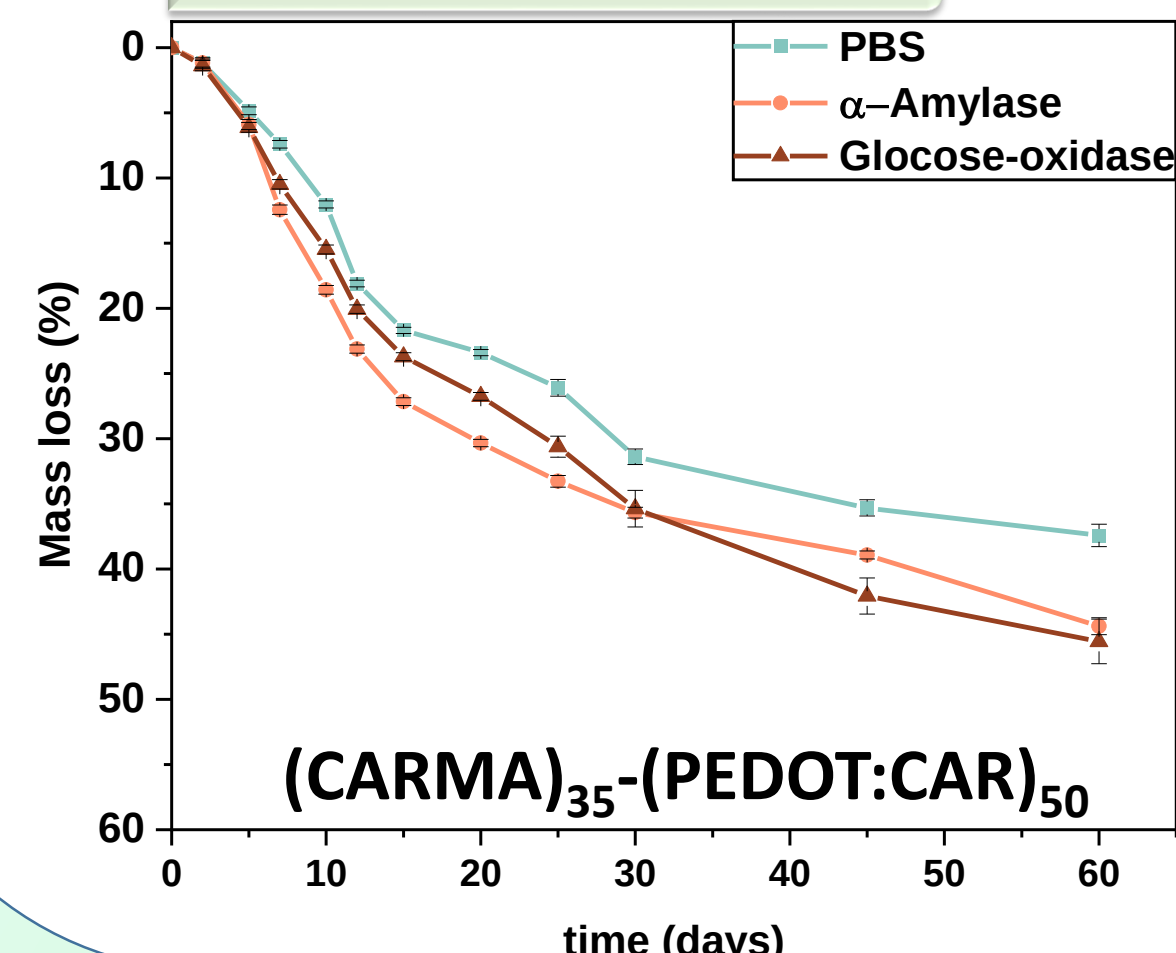
Photo-rheology of PEDOT:CAR inks



Electronic conductivities

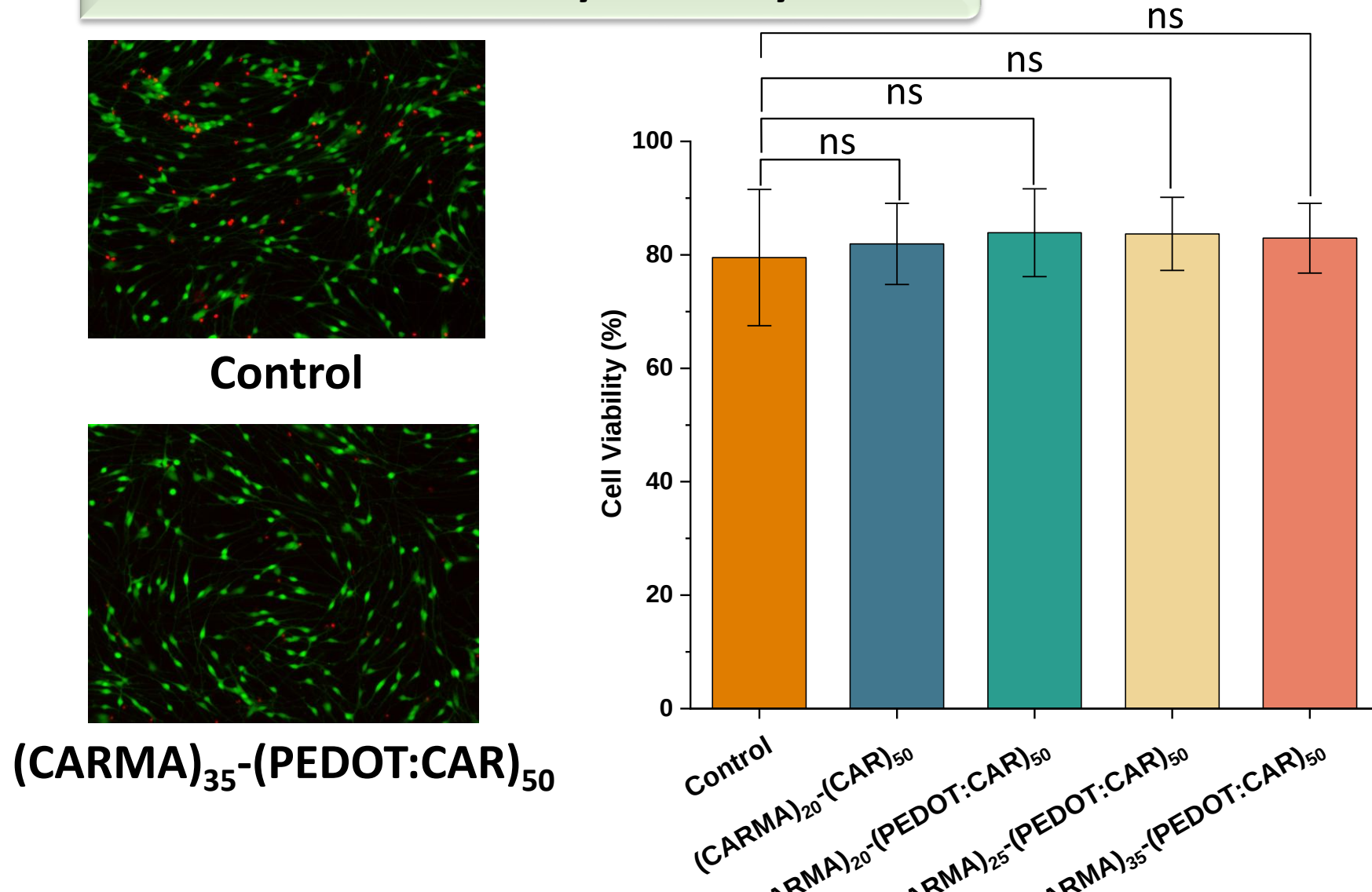


Degradation of hydrogels

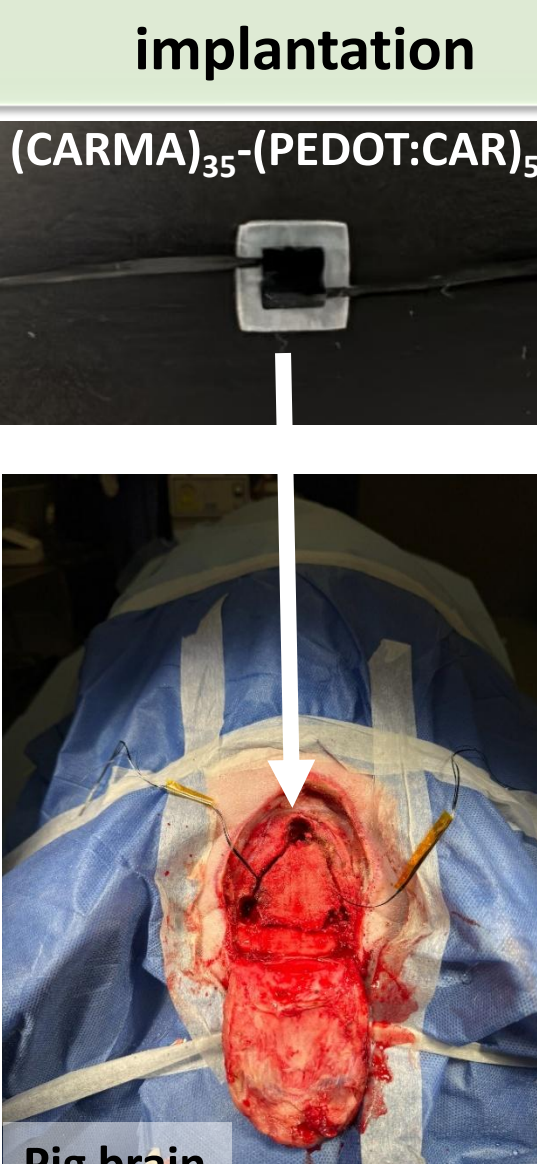


4. FROM IN VITRO TO IN VIVO TESTS

In vitro iPSC-Neurons cytotoxicity tests



In vivo chronic device implantation



5. CONCLUSIONS

- ✓ PEDOT dispersions were synthesized by **chemical oxidative polymerization** of EDOT in the presence of **biopolymers**: κ-carrageenan (CAR), Alginate (ALG), Inulin (INU)
- ✓ PEDOT:CAR showed the highest **conductivity (0.1 S cm⁻¹)** and stability
- ✓ CAR was partially methacrylated (MA) to get a photocrosslinkable polymer (CARMA) for **3D printing** of **shape-defined hydrogels** via digital light processing (DLP)
- ✓ Hydrogels showed **degradability** (~ 50% mass loss) in enzymatic media
- ✓ Hydrogels were **non-cytotoxic** in contact with iPSC-Neurons
- ✓ The 3D printed **hydrogels** were **implanted** in a **pig's brain** and the **intracranial pressure (ICP)** was successfully recorded.