Fluorescent and Printable Aromatic Polyether Sulfones for Polymer Light Emitting Diodes-PLEDs

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Introduction

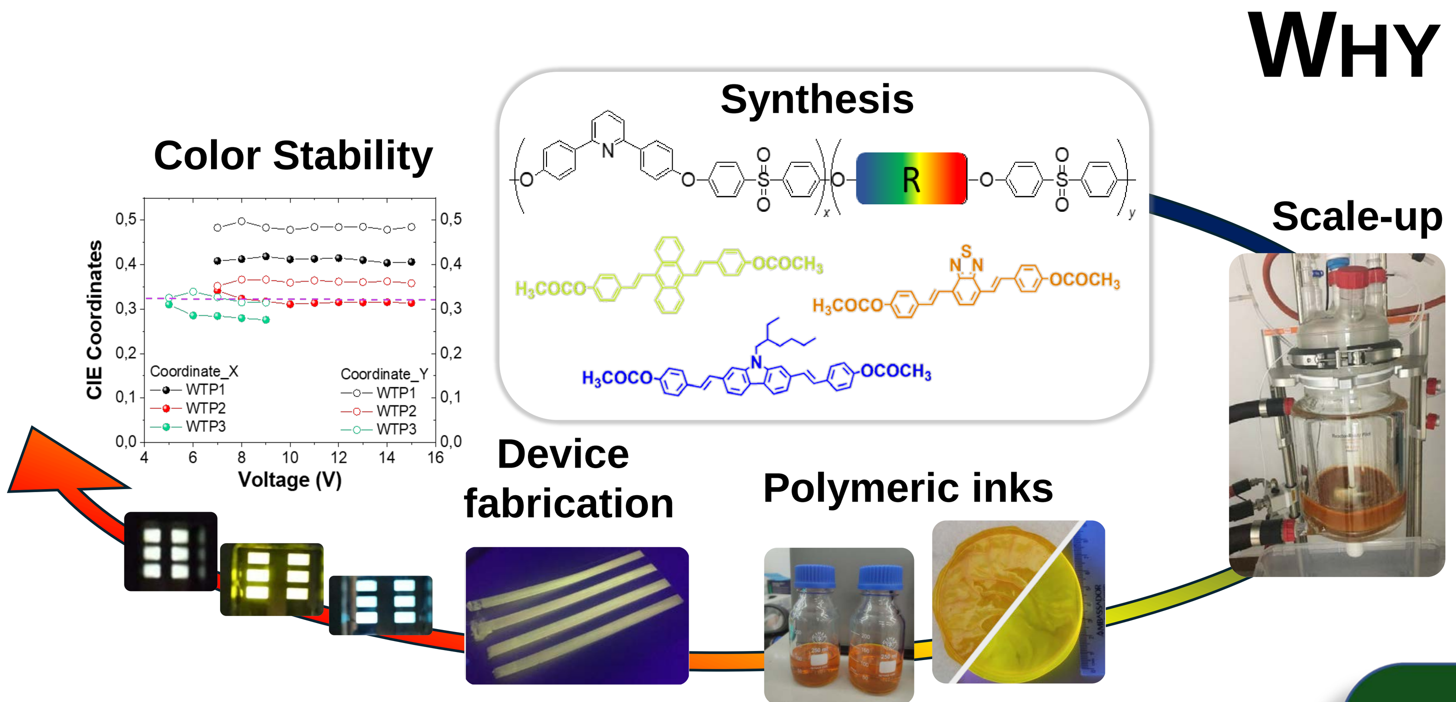
Efficient, durable, and reliable light emitting diodes (LEDs) of desired shape, size, color and flexibility for solid-state lighting is a major area of current research and industrial interest. Polymer Light Emitting Diodes (PLEDs), show great promise as candidates for future lighting applications due to their high processability, simple construction and large-area coverage. We developed:

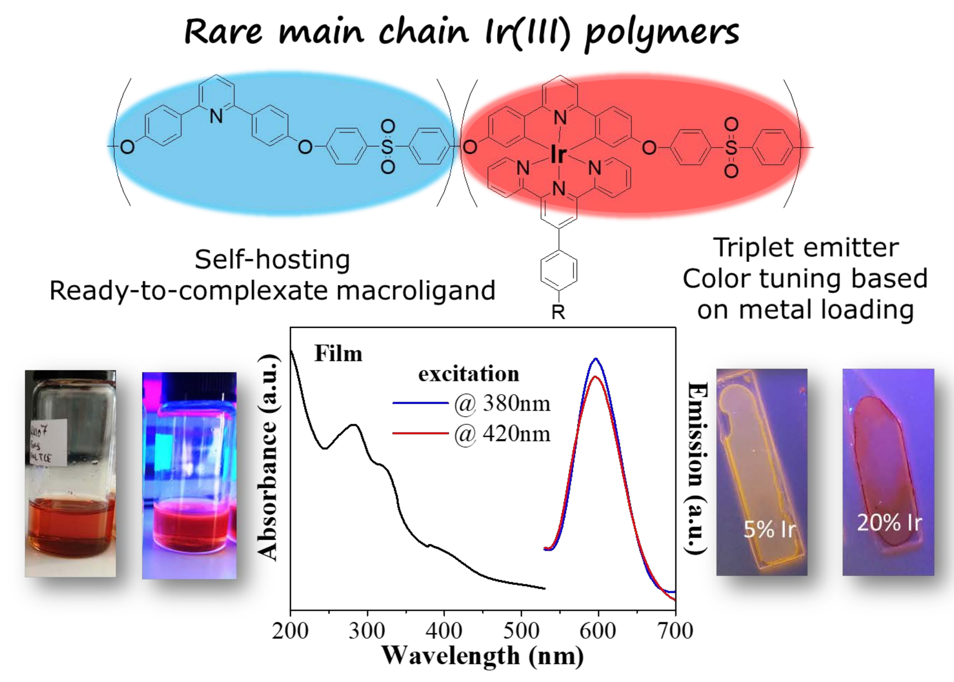
- ✓ **High Molecular weight** poly(ether)s, with great film-forming properties.
- ✓ Soluble, **scalable**
- ✓ No catalyst during polymerization, **less environmental burden.**
- ✓ **Easy color fine-tuning** (blue, yellow, red and white emission).
- ✓ Facile post-modification of polymers with metals to take advantage of **triplet emission.**

Our current effort is focused on enhancing the sustainability of our poly(ether)s by incorporating greener alternatives as solvents. In particular, we aim to produce polymeric inks from **green solvents** (e.g., γ-Valerolactone, TamiSolve, 2-MeTHF, water, ethanol). By introducing ionic sulfonic acid groups, the poly(ether)s have enhanced solubility in **water**, to meet the green and eco-friendly solubility requirements for the fabrication of PLED devices, using the following tools:

- ✓ Sulfonation is done **before** polymerization to have complete control over sulfonation degree.
- ✓ By fine-tuning the comonomer ratio we are turning **traditional hydrophobic** polymers to **partially hydrophilic**.
- ✓ **Ion-exchange** can lead to increased solubility in **alcohols.**

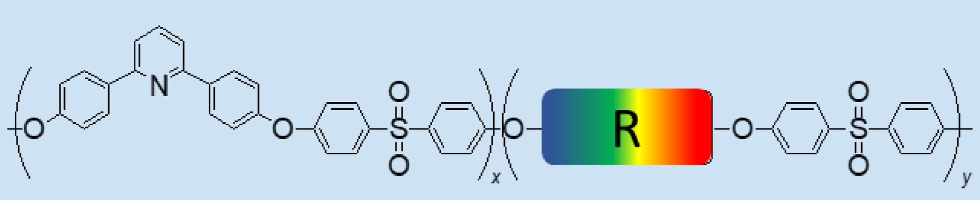
Why Polyethers?



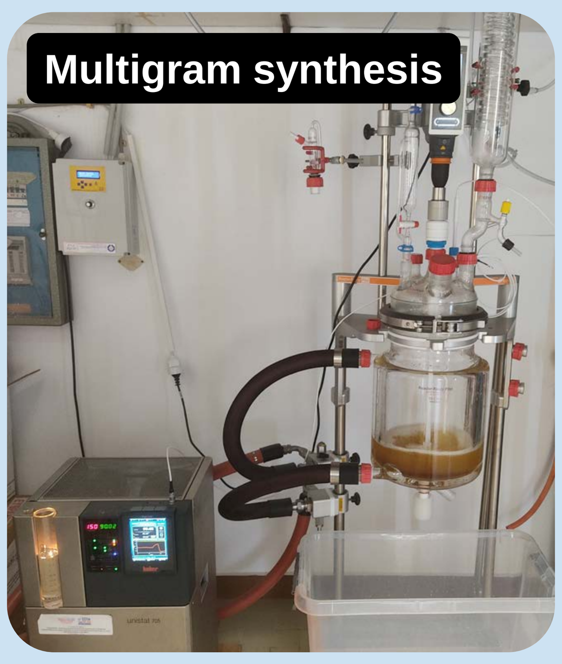


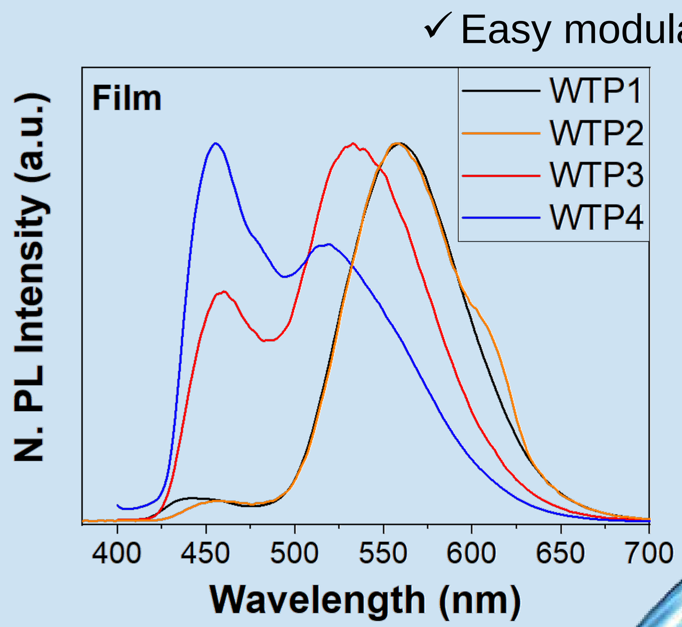
Results

Large scale synthesis

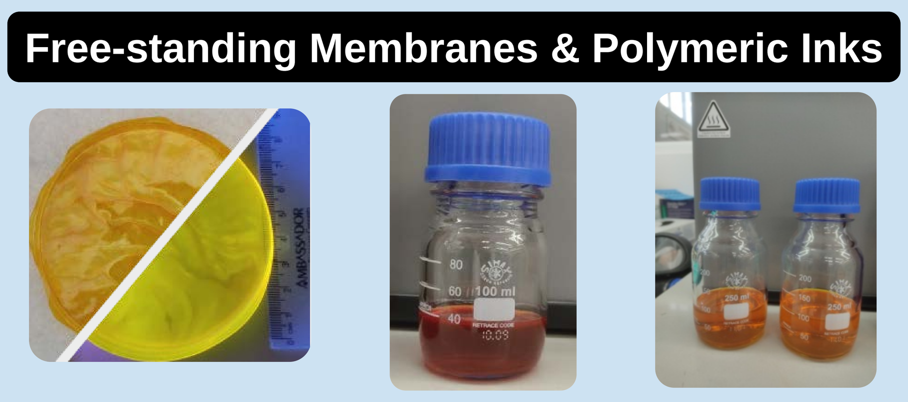


- ✓ No catalyst during polymerization
- ✓ High molecular weights
- ✓ Facile scale-up
- ✓ Easy modulation of emission



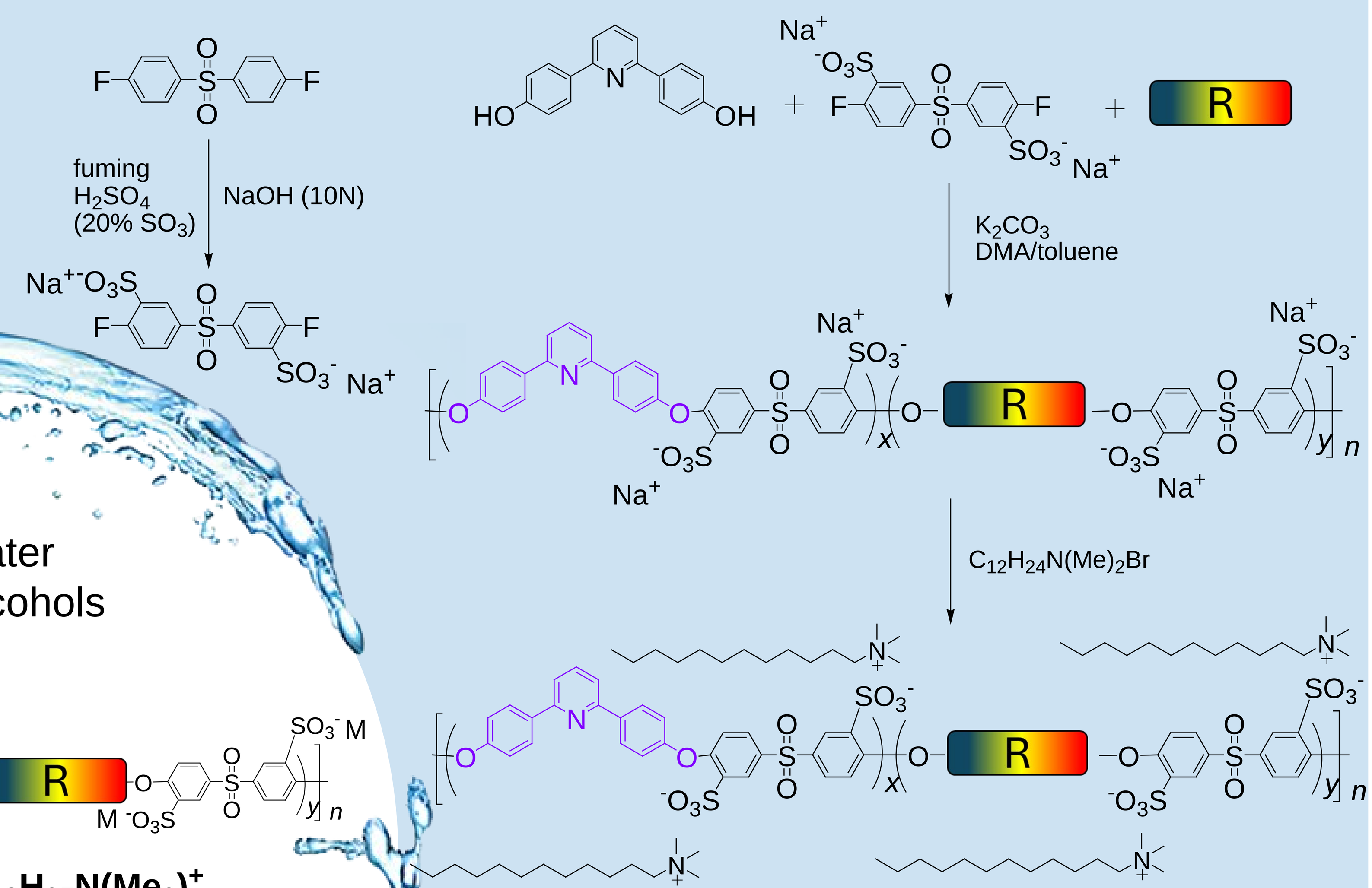


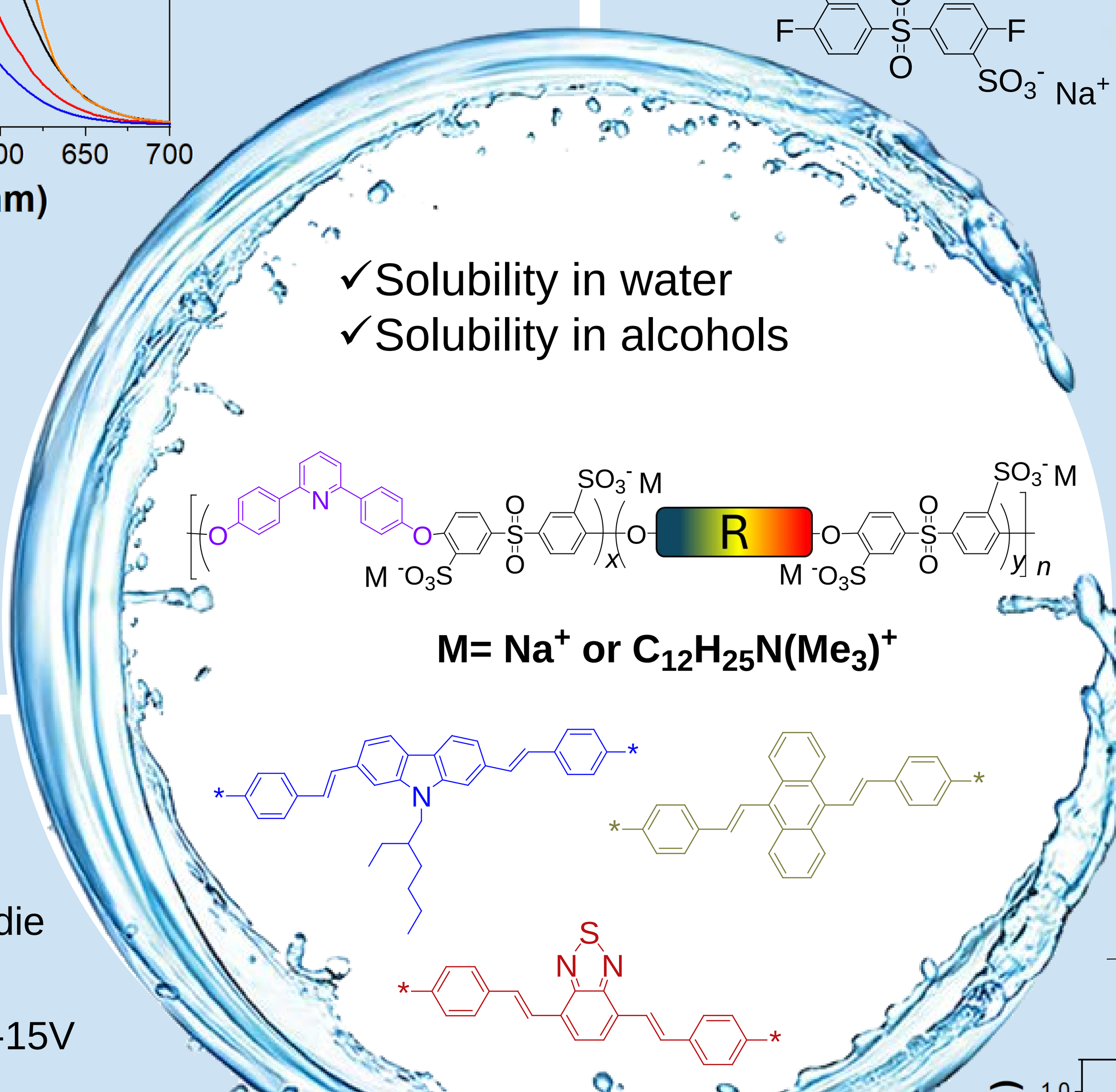
Free-standing Membranes & Polymeric Inks



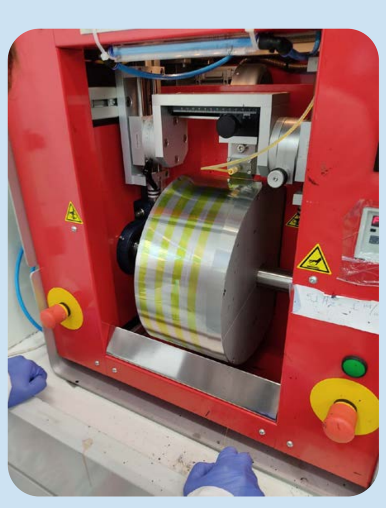
Functionalization for water & alcohol-solubility

- ✓ Incorporation of ionic groups to raise water/alcohol affinity
- ✓ Fine-tuning of comonomer ratio to achieve solubility in water

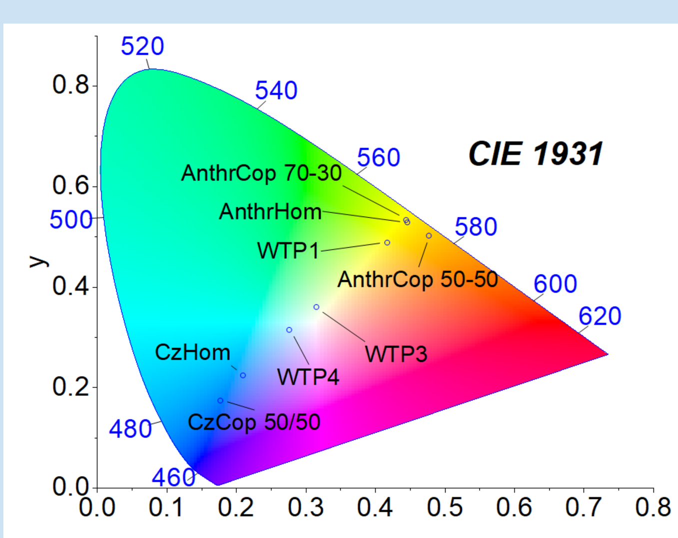


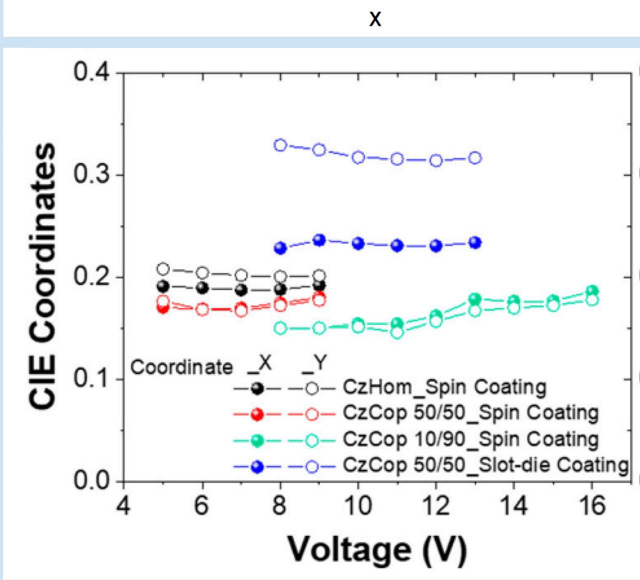


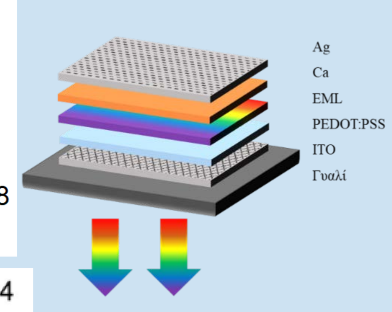
Device printing



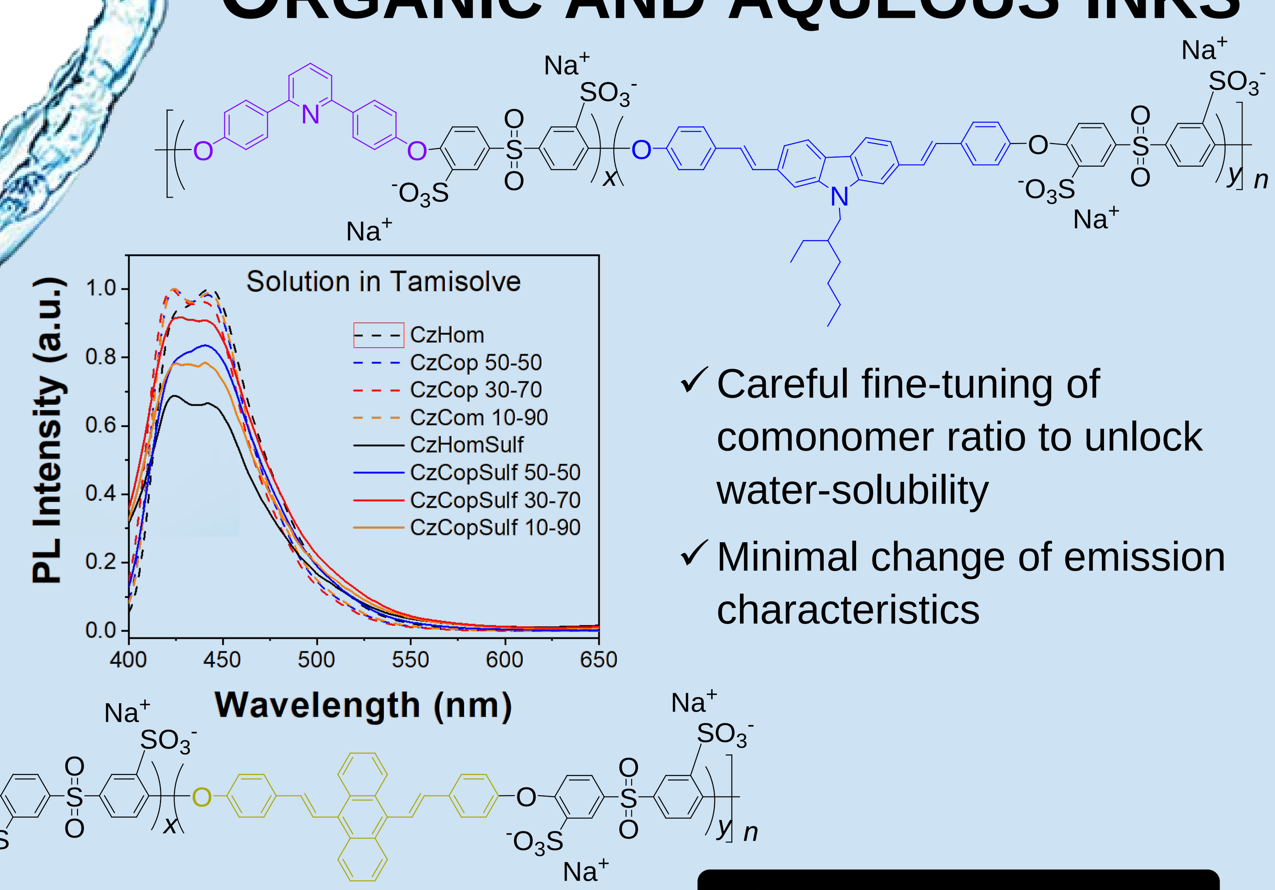
- ✓ Facile EML printing via slot-die coating
- ✓ Coordinate stability from 5V-15V for WTPs



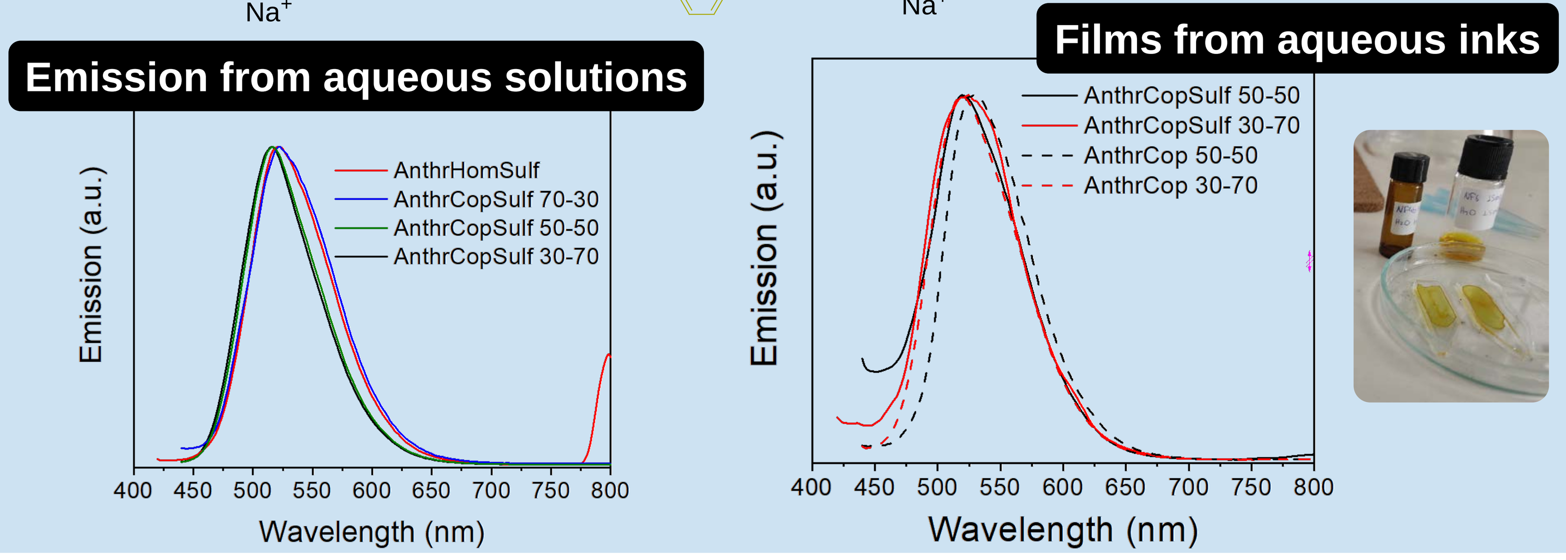




Organic and aqueous inks



- ✓ Careful fine-tuning of comonomer ratio to unlock water-solubility
- ✓ Minimal change of emission characteristics



Conclusions

- ✓ Printable, high molecular weight poly(ether)s have been synthesized.
- ✓ Facile mutigram synthetic processes.
- ✓ Slot-die coated EML for PLEDs.
- ✓ Facile modification of poly(ether)s for solubility in **water** and **alcohols.**
- ✓ Emission characteristics in water similar to organosoluble polymers.
- ✓ High control of sulfonation degree via synthesis.
- ✓ Fine-tuning of comonomer ratio produces water-soluble copolymers.

References

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