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UNIVERSITY OF SEOUL

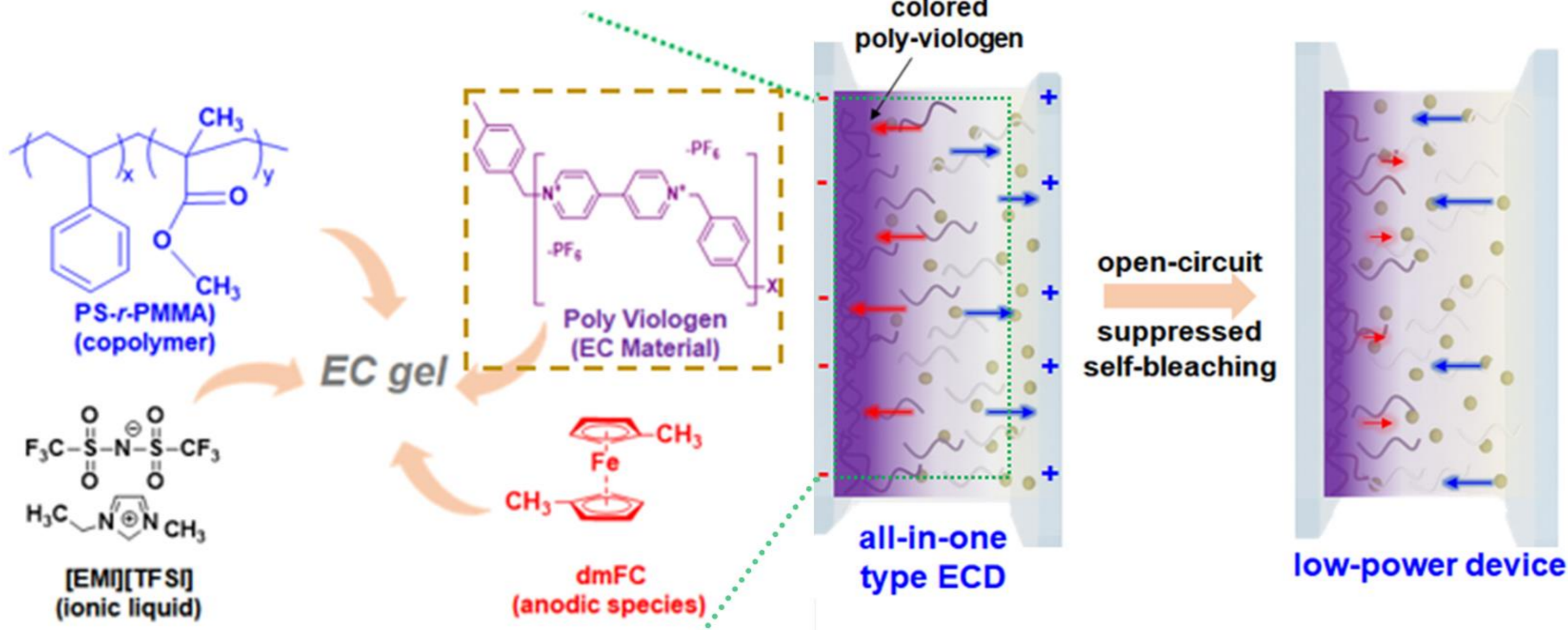
Ultra-Low Power Electrochemical Heat Shutters Based on Diffusion-Controlled Electrochromic Behaviors

Department of Chemical Engineering, University of Seoul

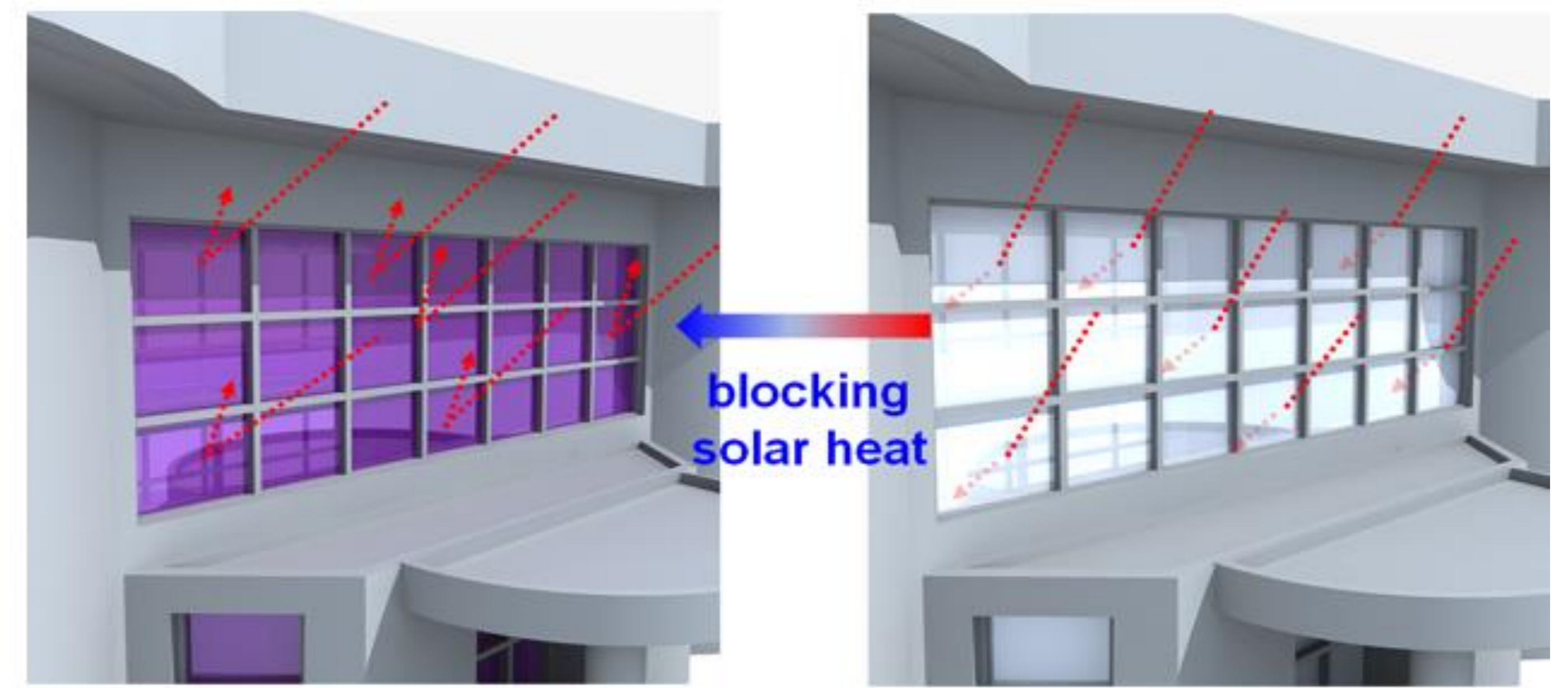
Ye Ryeong In, Seon Yeong Kim, and Hong Chul Moon*

Introduction & Objective

Diffusion-controlled electrochromic devices

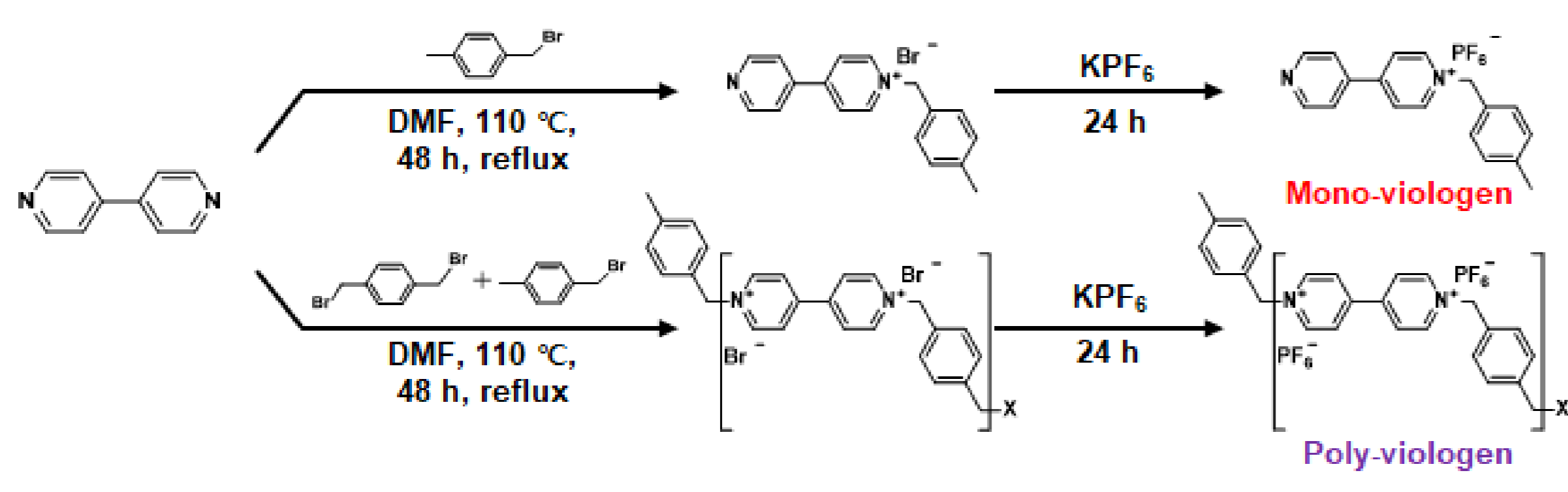


Effective Solar Heat Shutter



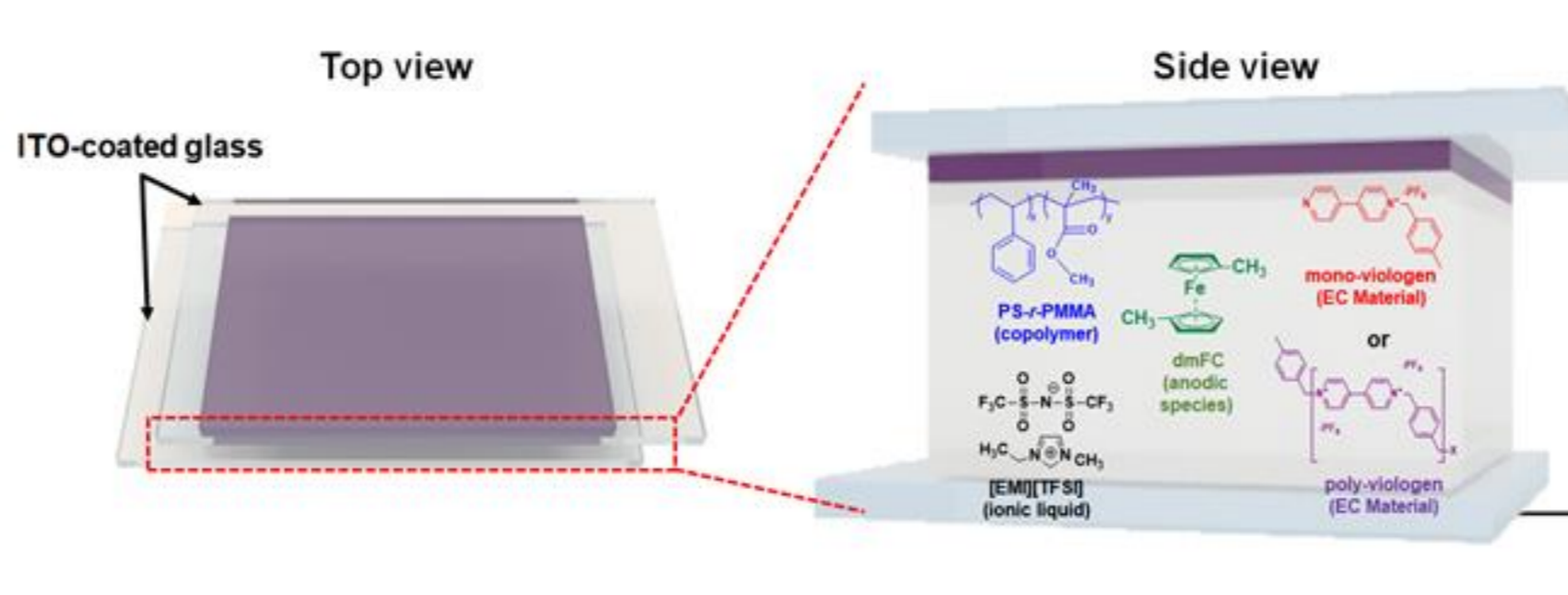
Results & Discussion

Synthetic Routes of Mono- and Poly-viologens

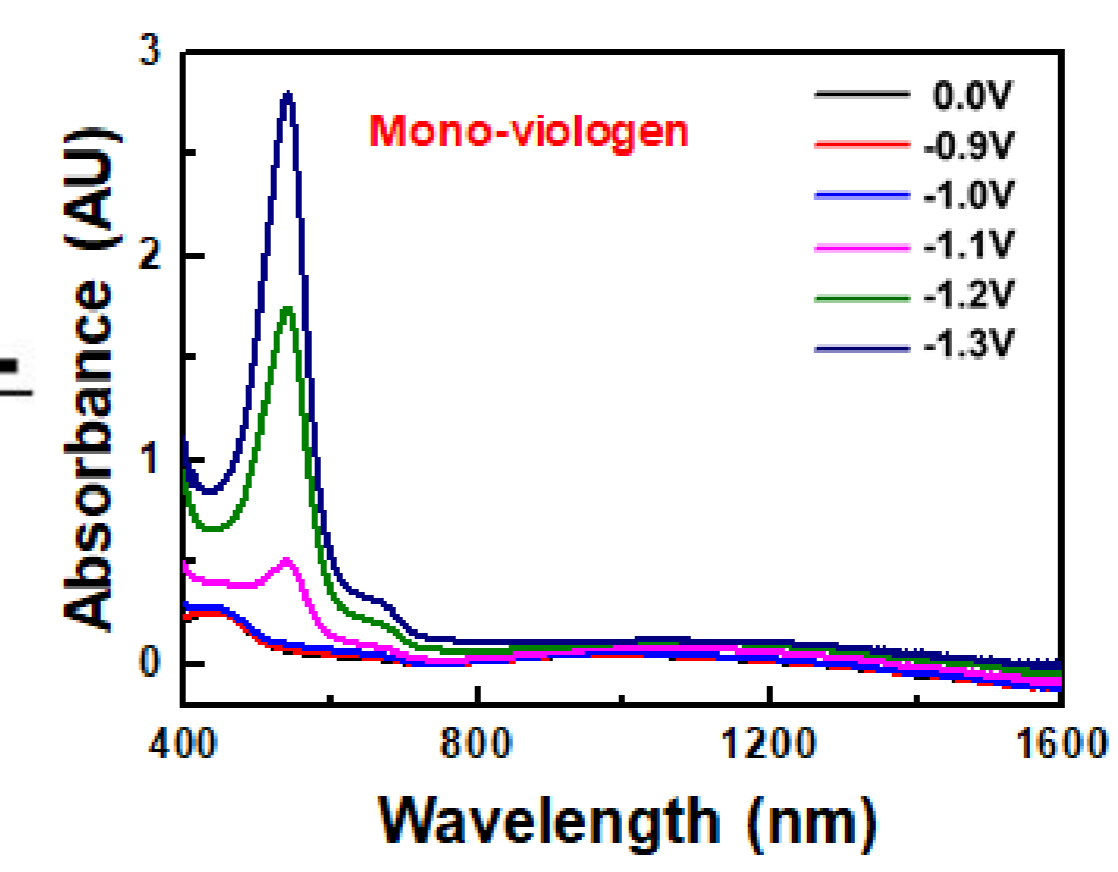


Optical Properties of ECDs

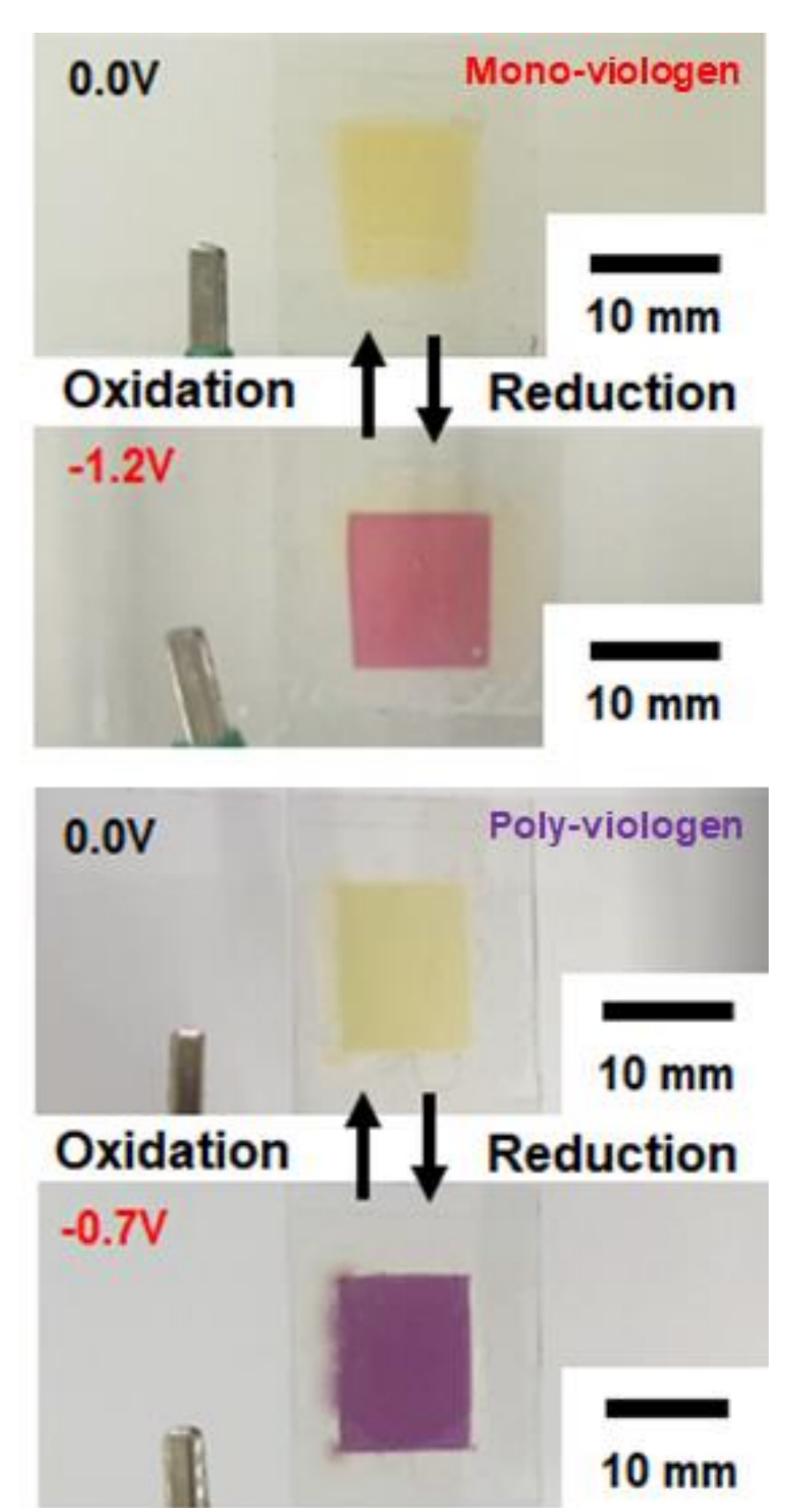
1. Schematic illustration



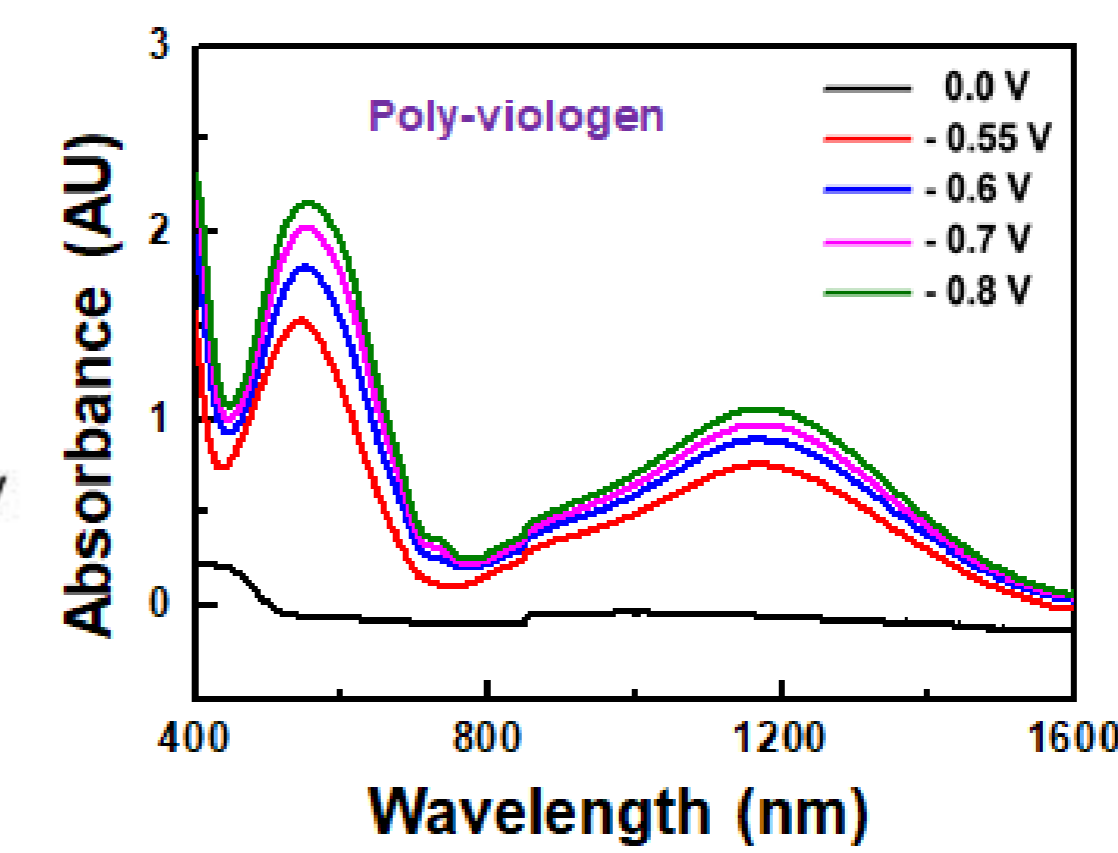
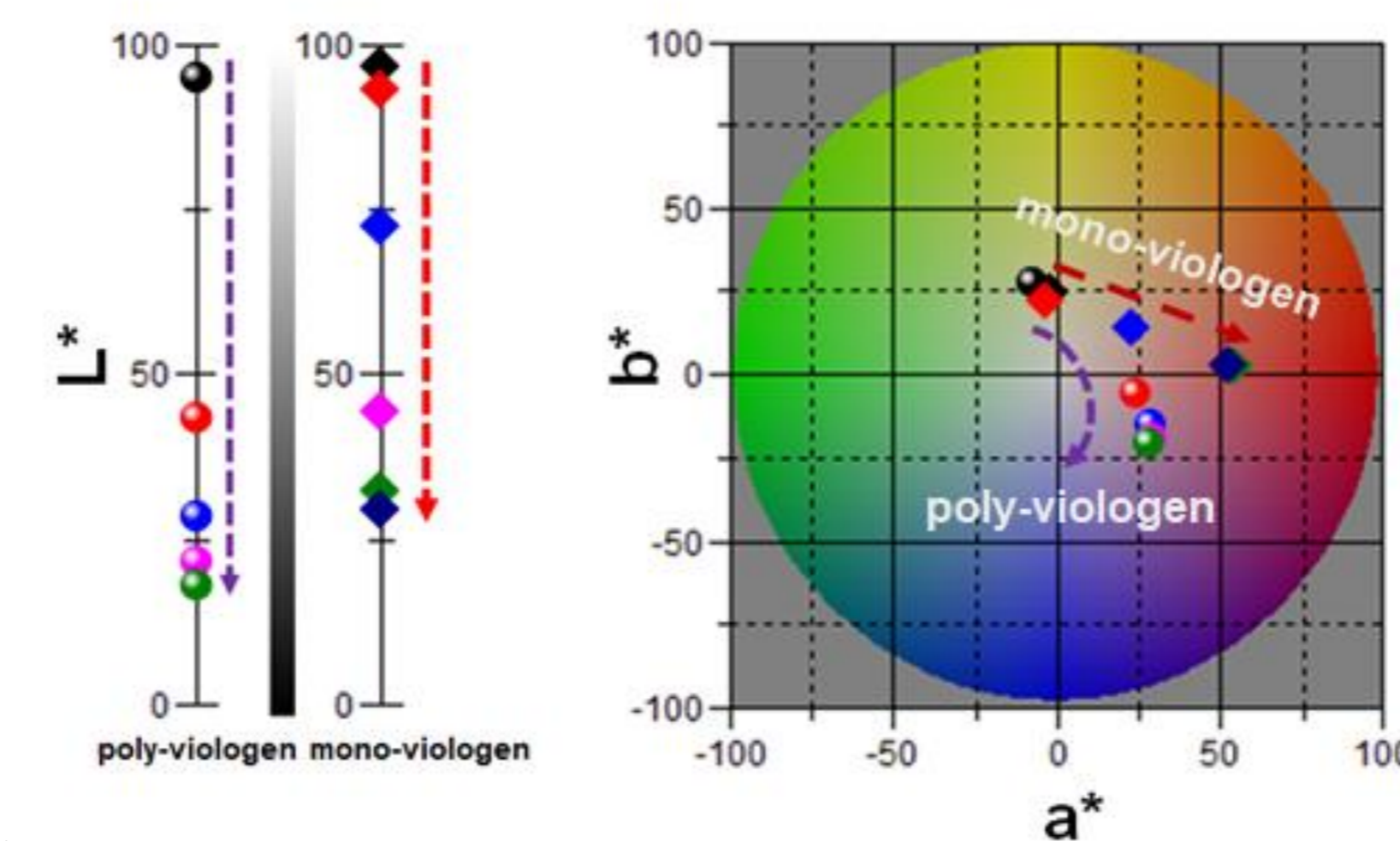
2. UV-vis-NIR spectra



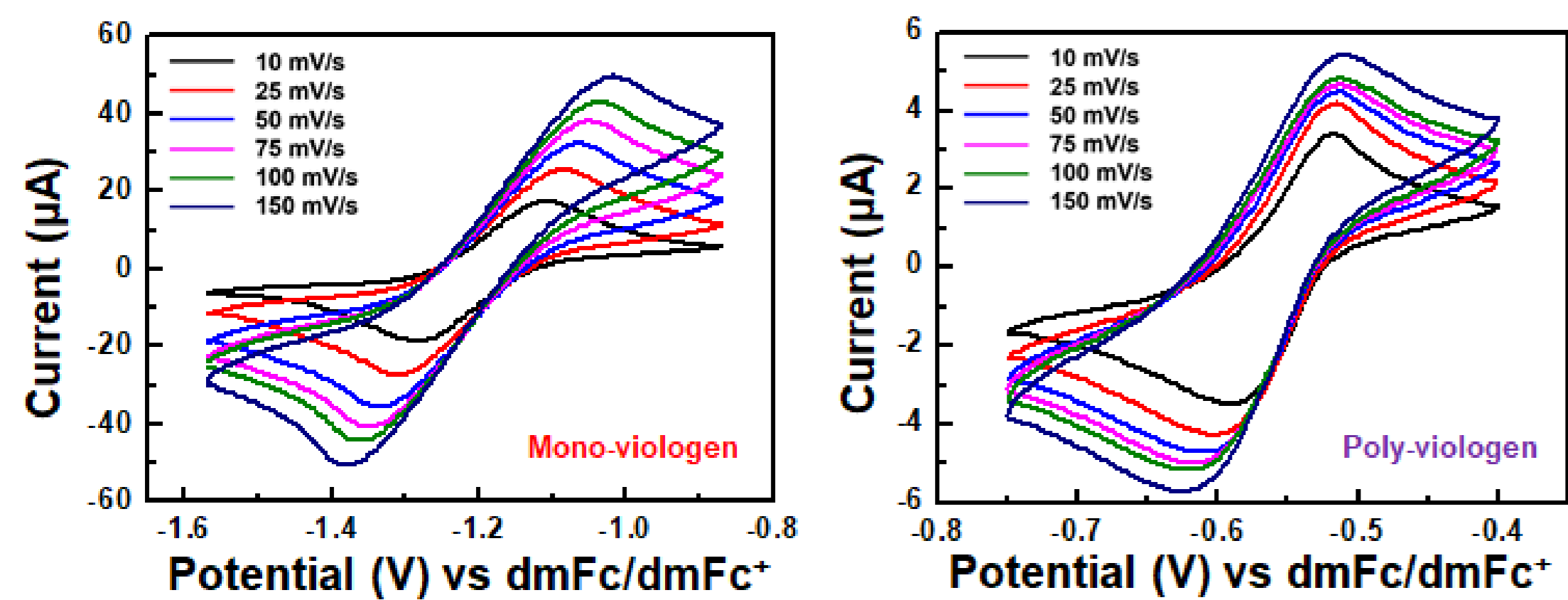
3. Photographs



4. CIELAB Color Coordinates

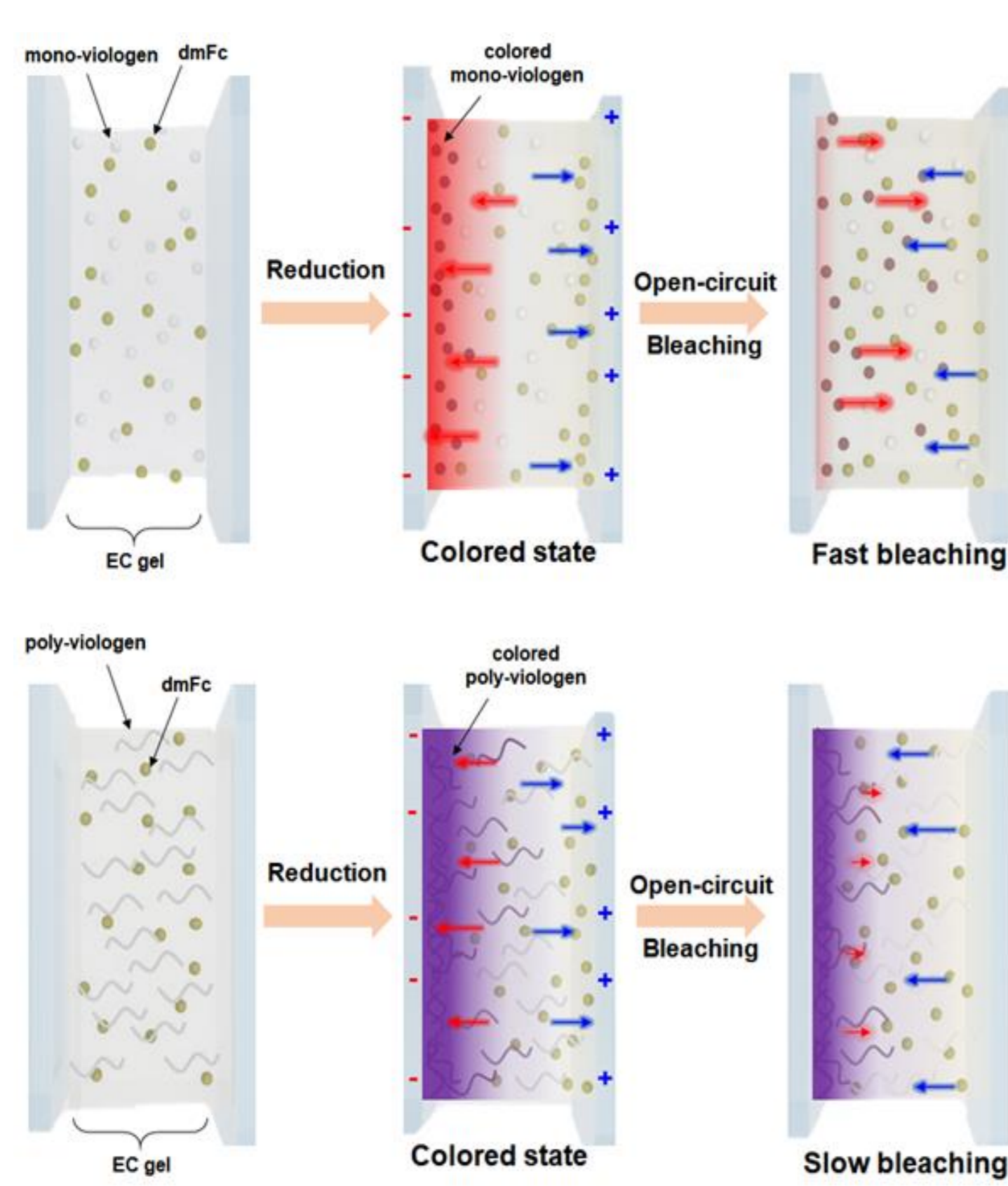


Cyclic Voltammograms

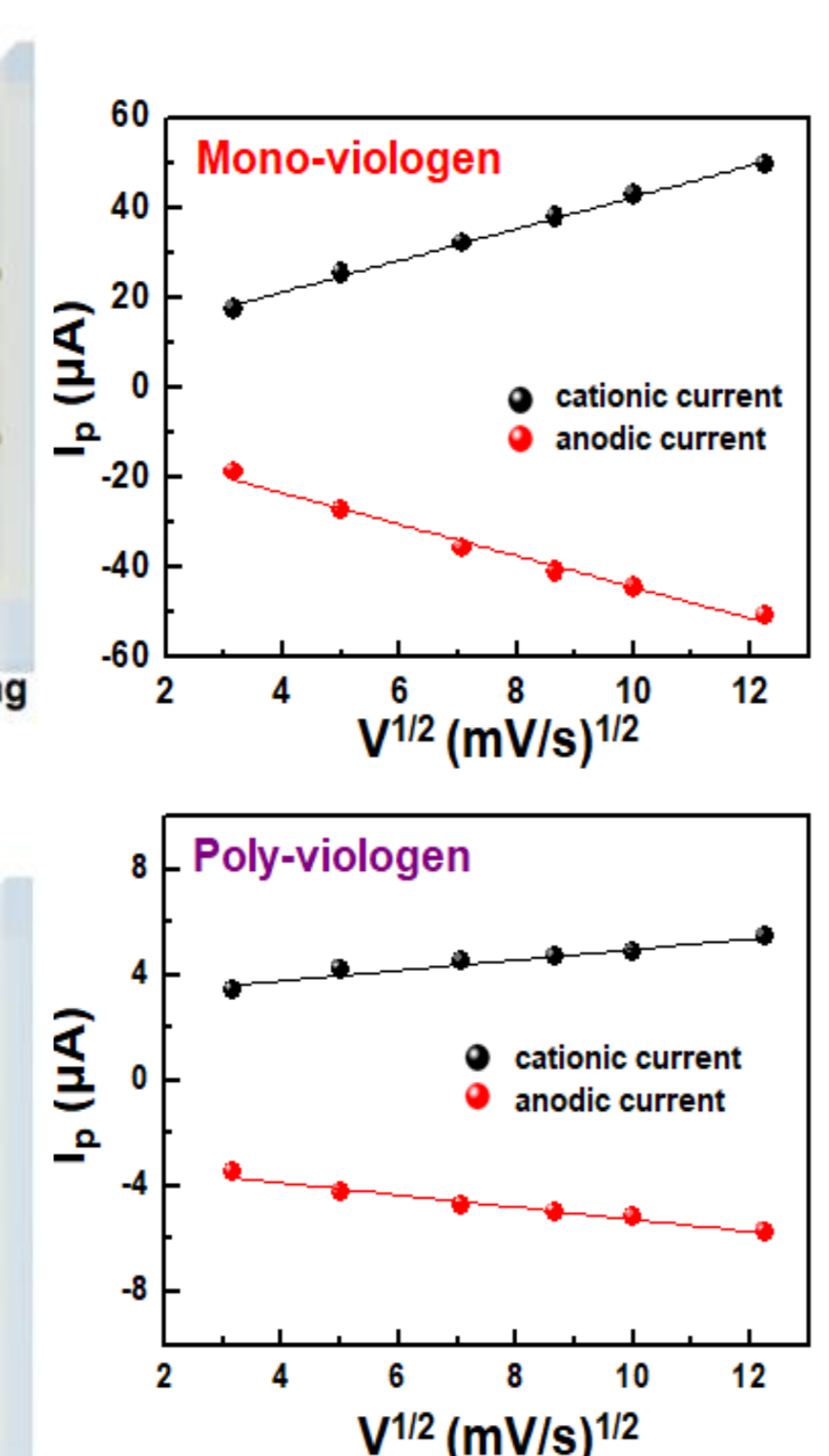


Characteristics of ECDs

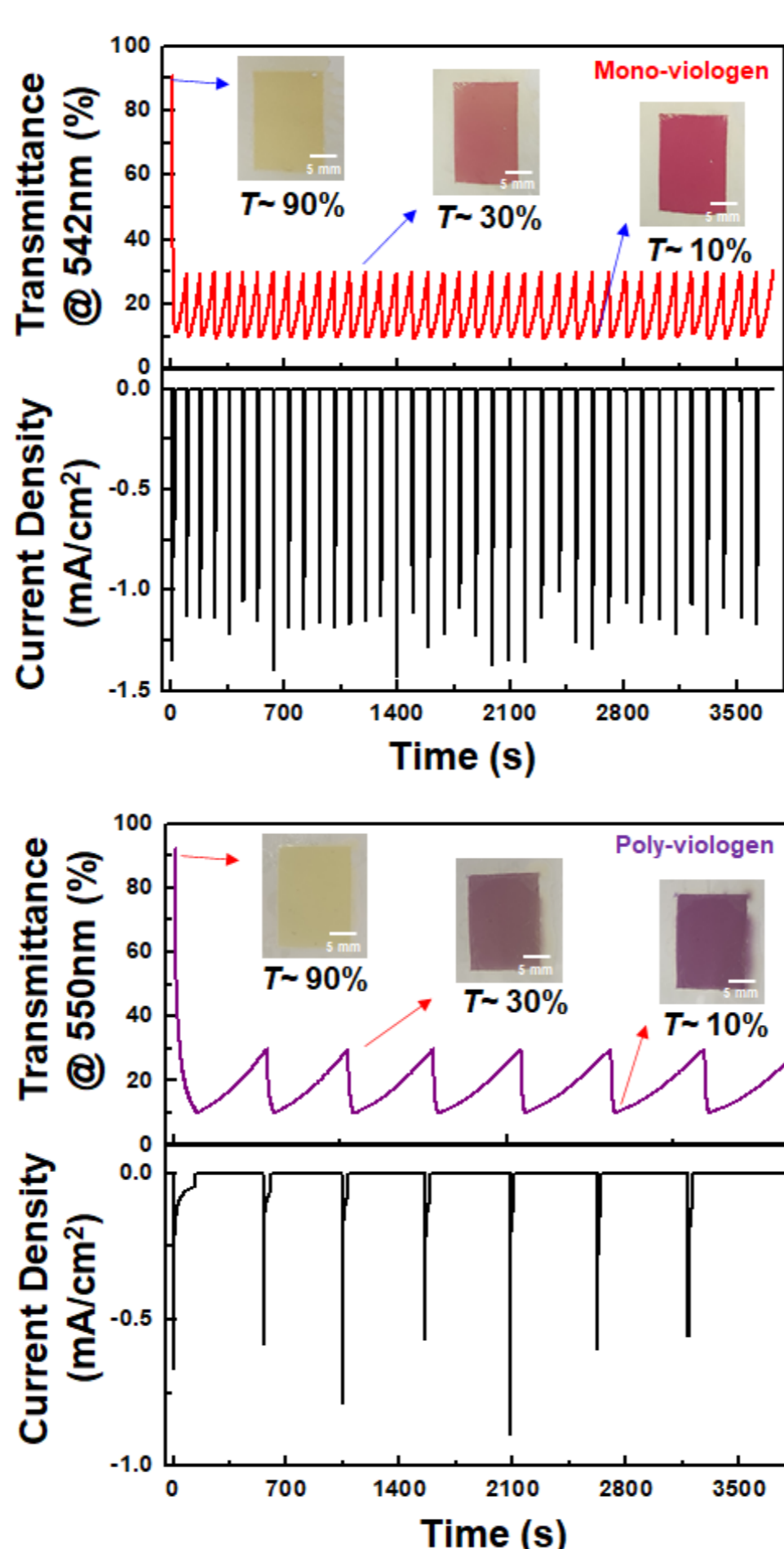
1. Schematic Diagram of ECDs



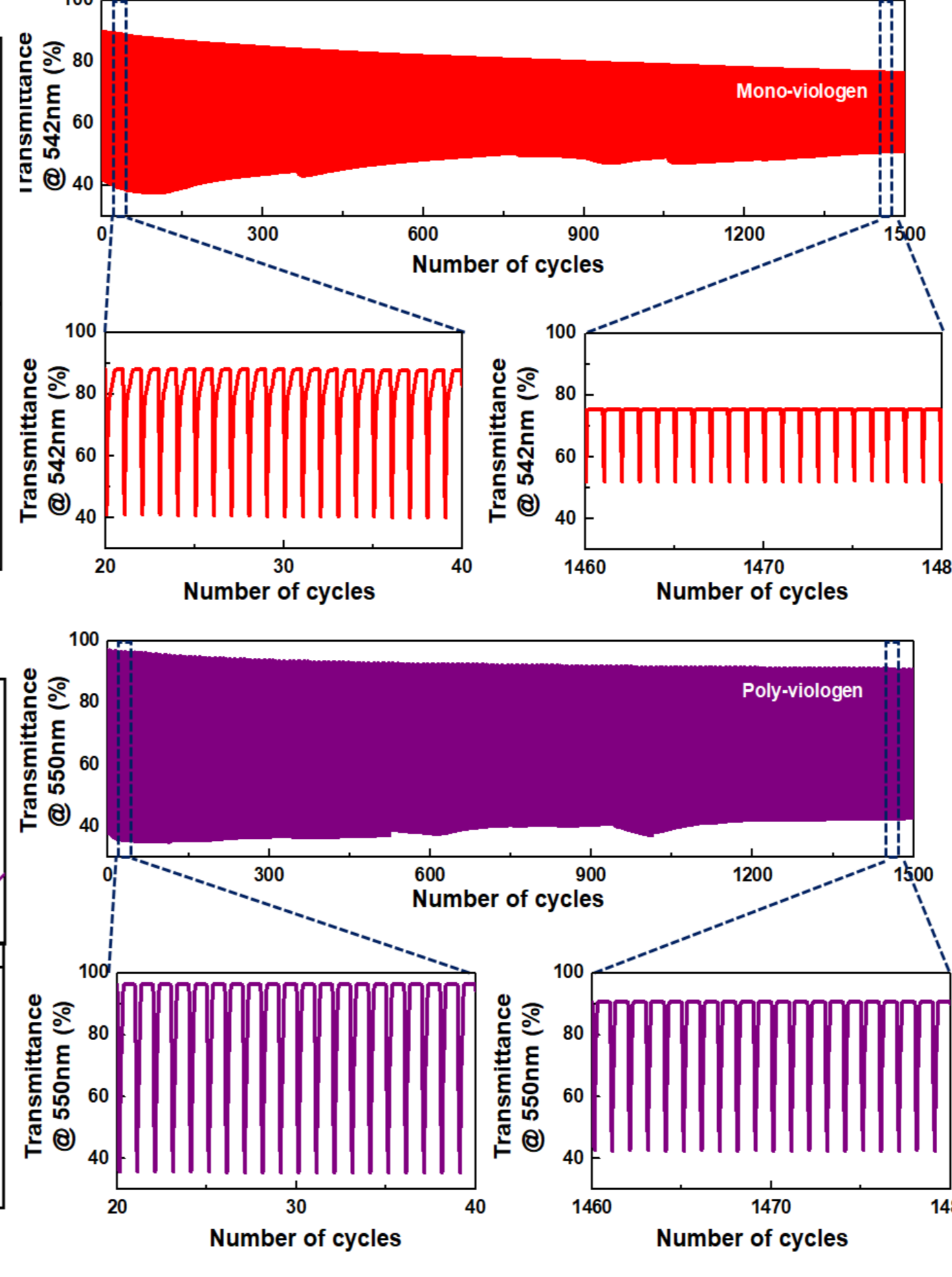
2. Plots of Anodic and Cathodic Current Peaks



3. Dynamic Profiles

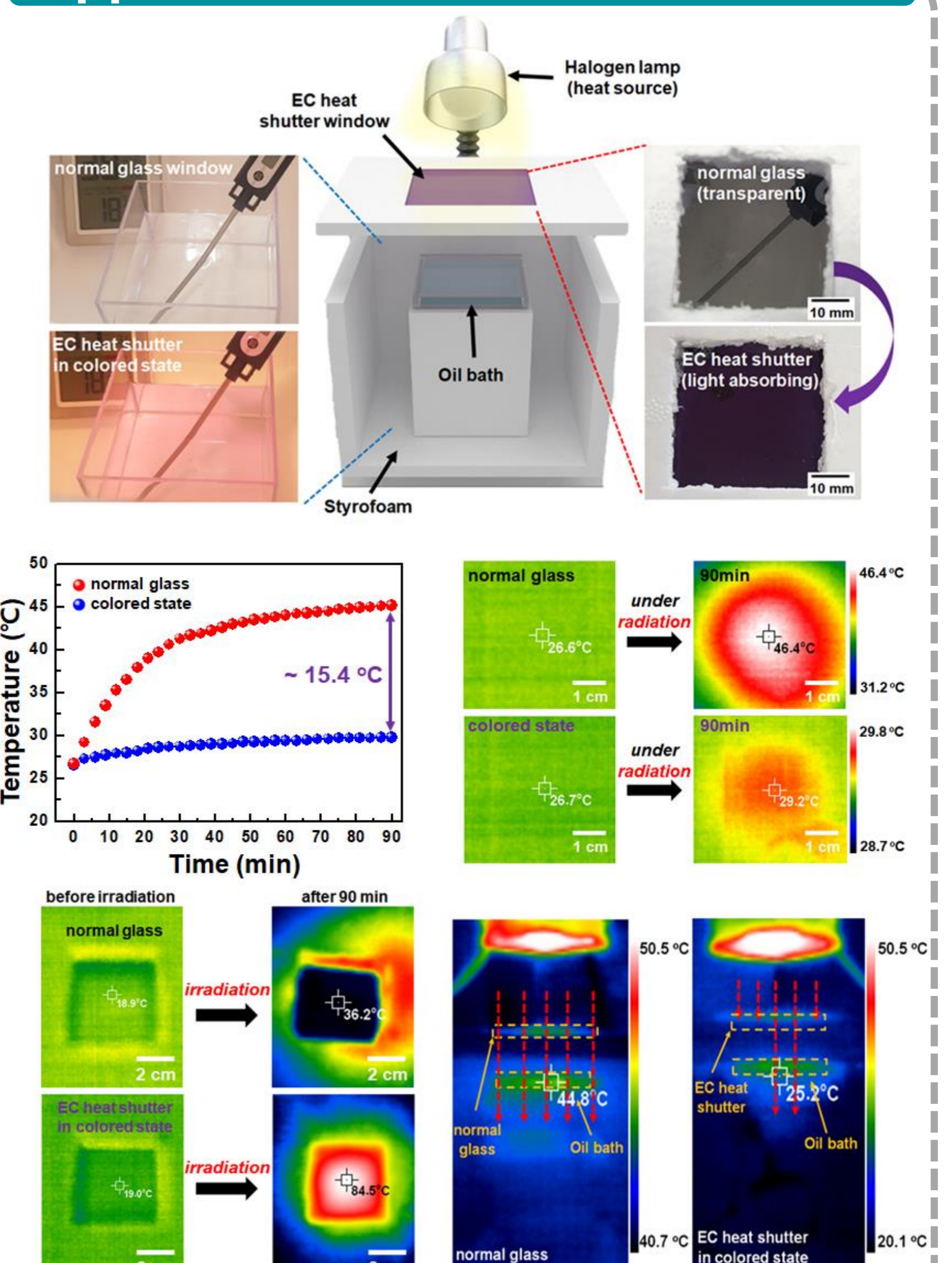


4. Cyclic Operational Stability



EC Chromophore	coloration voltage (V)	ΔT_{max} (%)	t_c (s)	t_{open} (s)	η (cm ² /C)	power consumption (µW/cm ²)
mono-viologen	-1.2	~92	~13	~178	~52.5	~86.6
poly-viologen	-0.7	~93	~115	~1276	~59.2	~8.3

Application to Solar Heat Shutter



Summary

- In this study, high molecular weight polymeric viologens (poly-viologens) were designed to lower the diffusivity of EC chromophores and to minimize self-bleaching.
- In comparison with devices based on mono-viologens corresponding to the monomer of poly-viologens, the advantages of poly-viologen-containing ECDs include lower coloration voltage, lower power consumption to maintain a colored state and higher coloration/bleaching cyclic stability.
- Moreover, the strong absorption of the near-IR region of poly-viologen ECDs was exploited to demonstrate their feasibility as effective heat shutters.