Polyviologen for Highly Effective Supercapacitor

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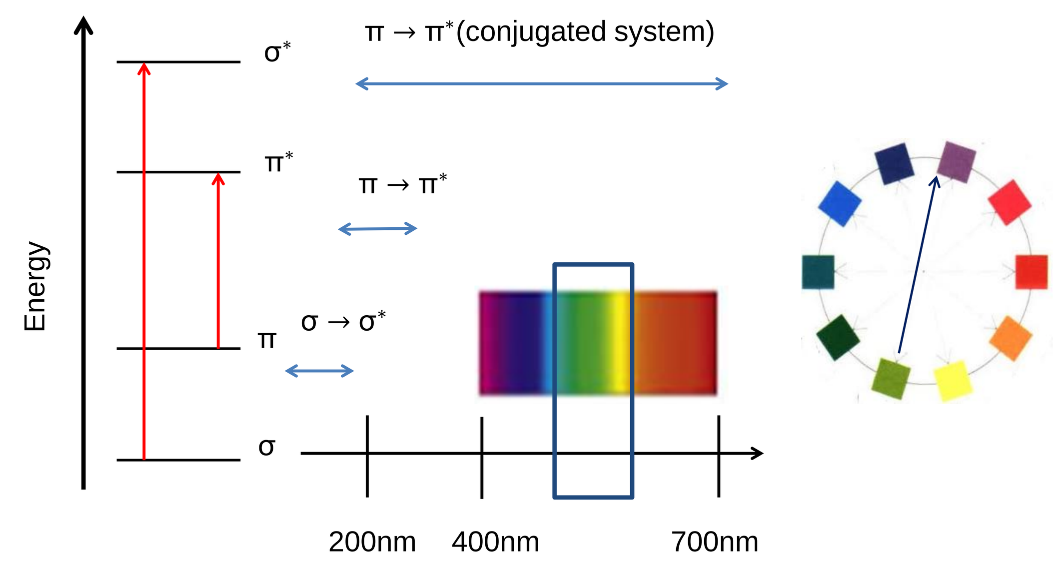
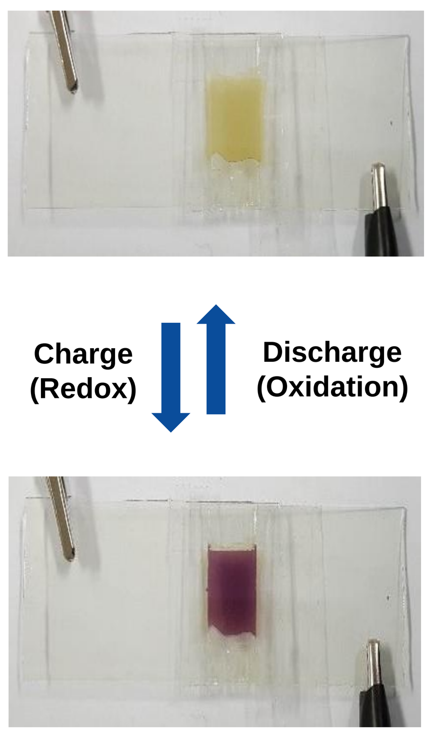
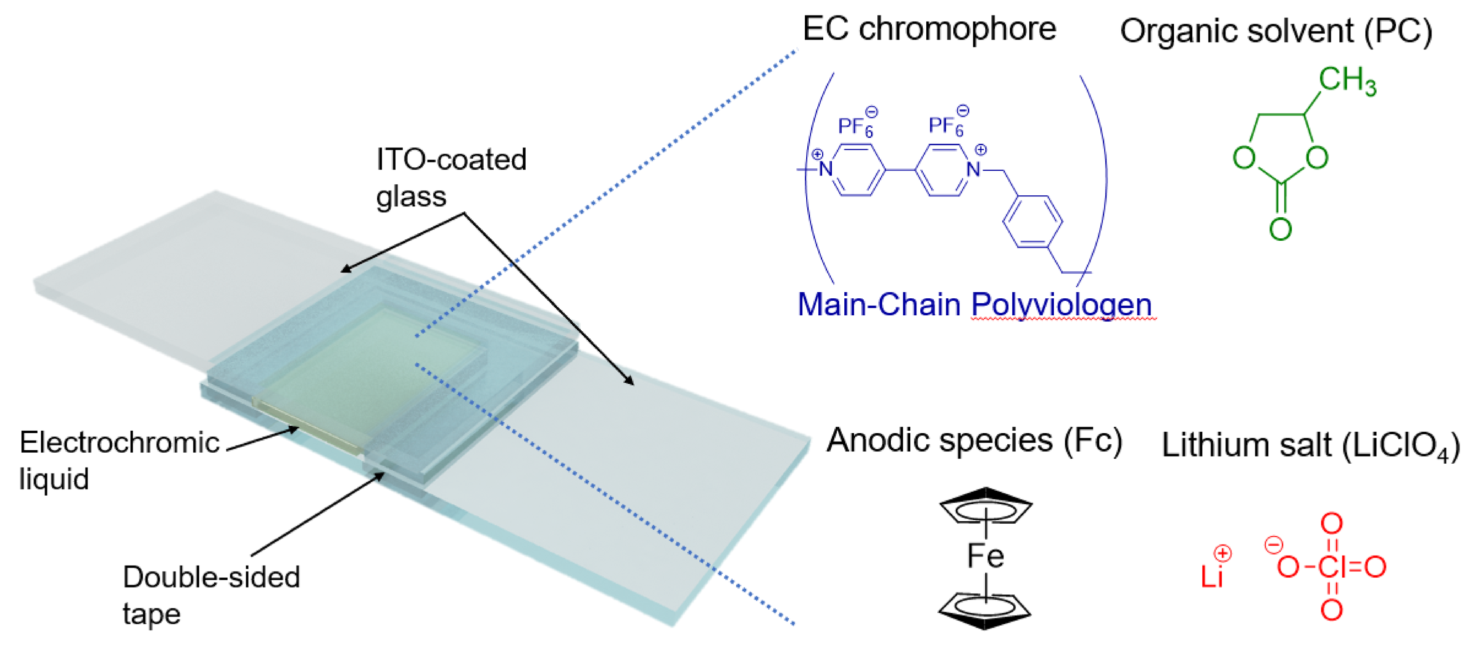
Introduction & Objective

Objective

- Find polyviologen which has optimum performance for supercapacitor.
- Produce simple supercapacitor using polyviologen.
- Check its performance and compare with comparative group.
- Check its coloration characteristic.

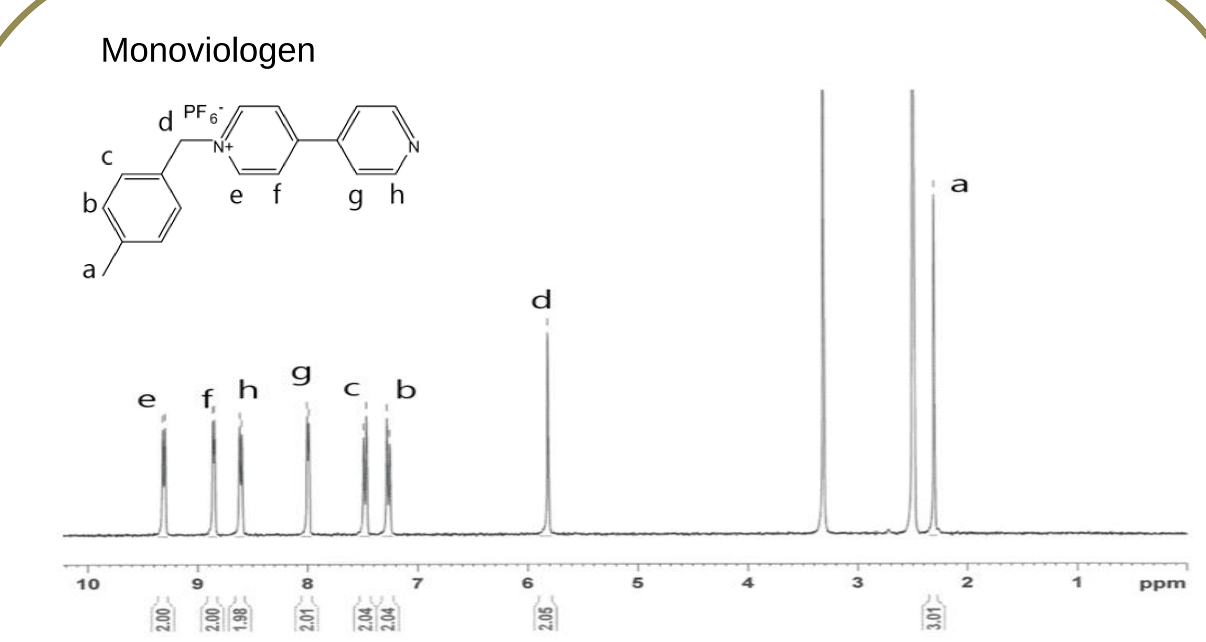


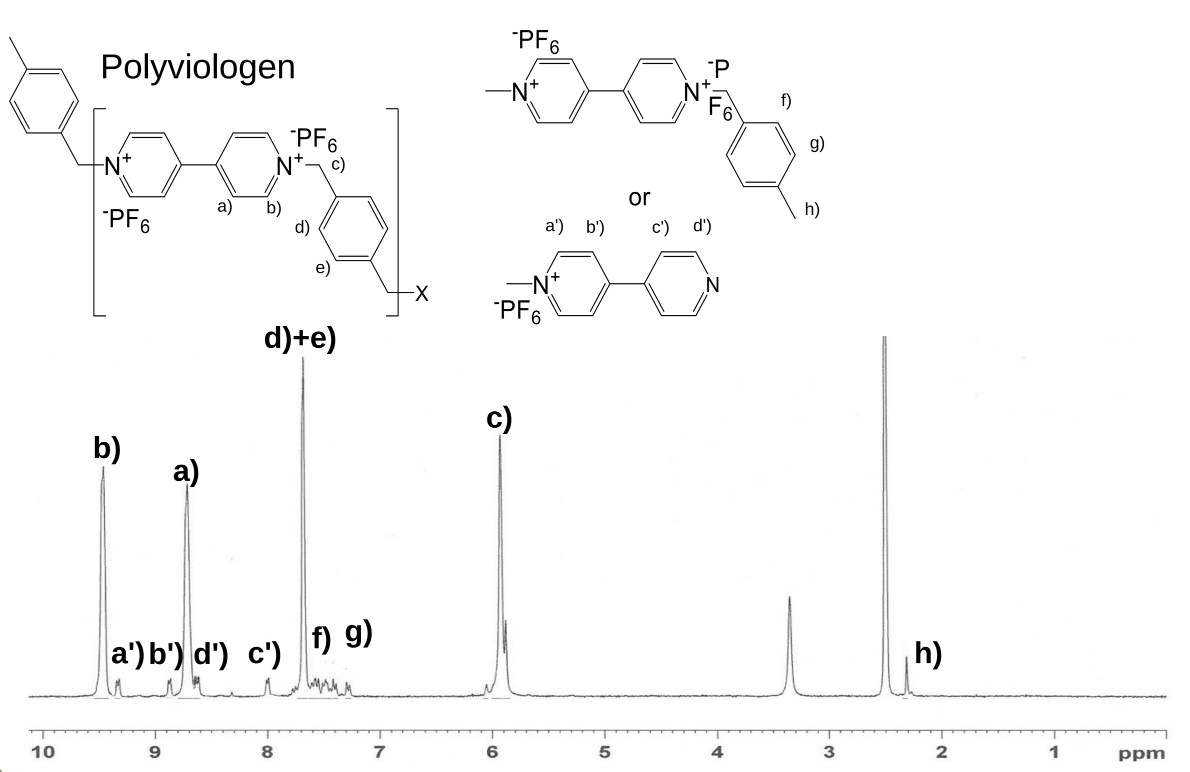




Results and Discussion

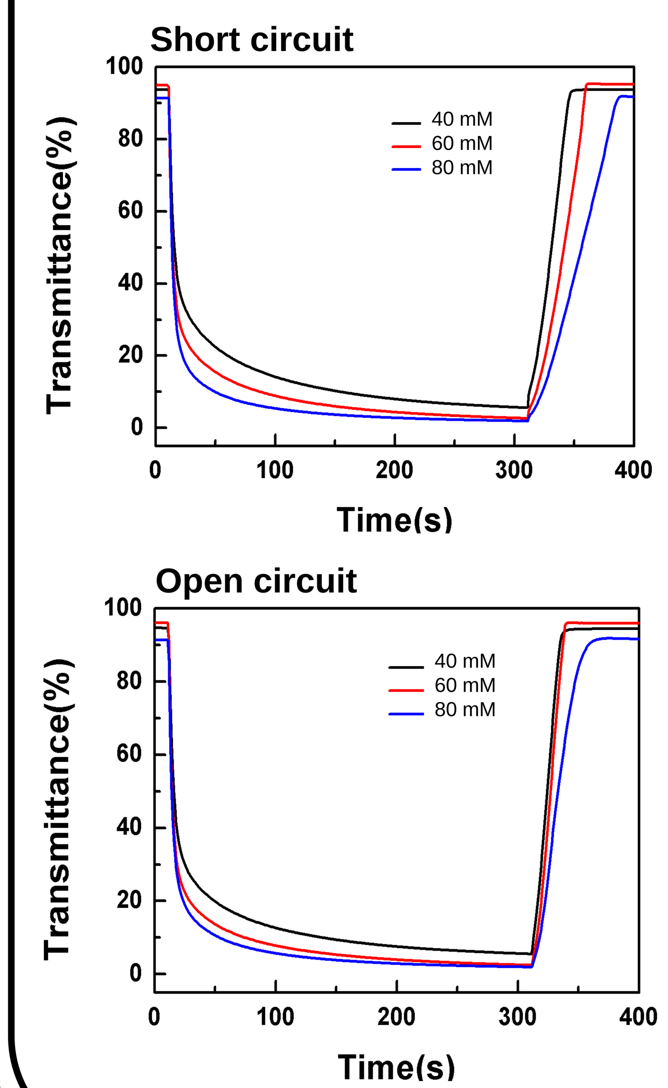
NMR analysis



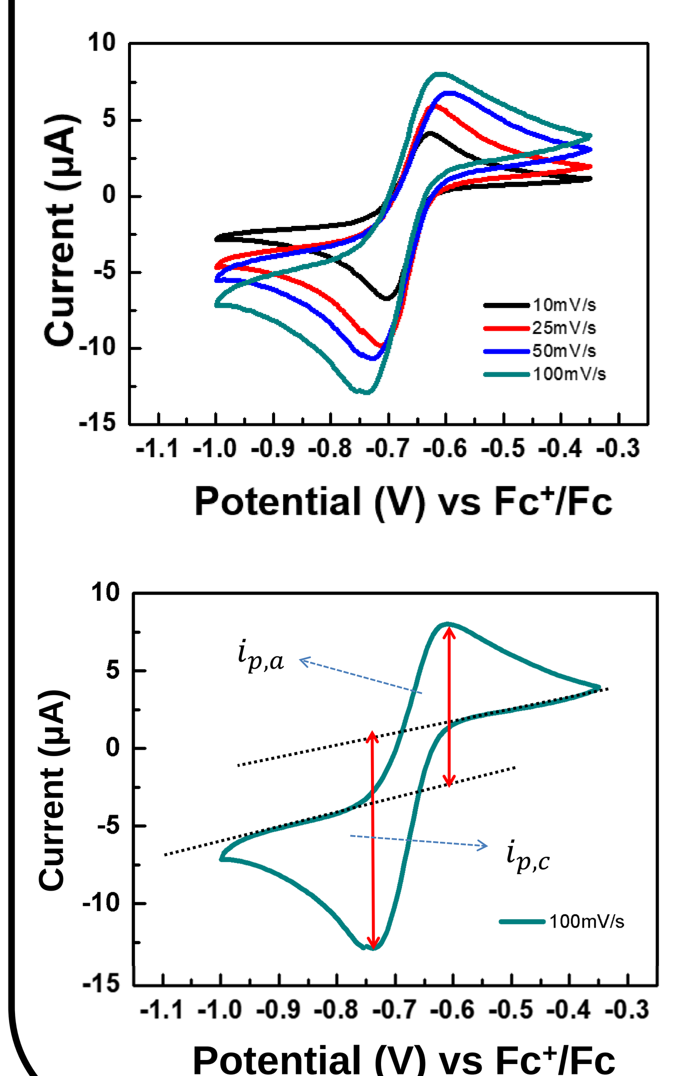


Performance of polyviologen

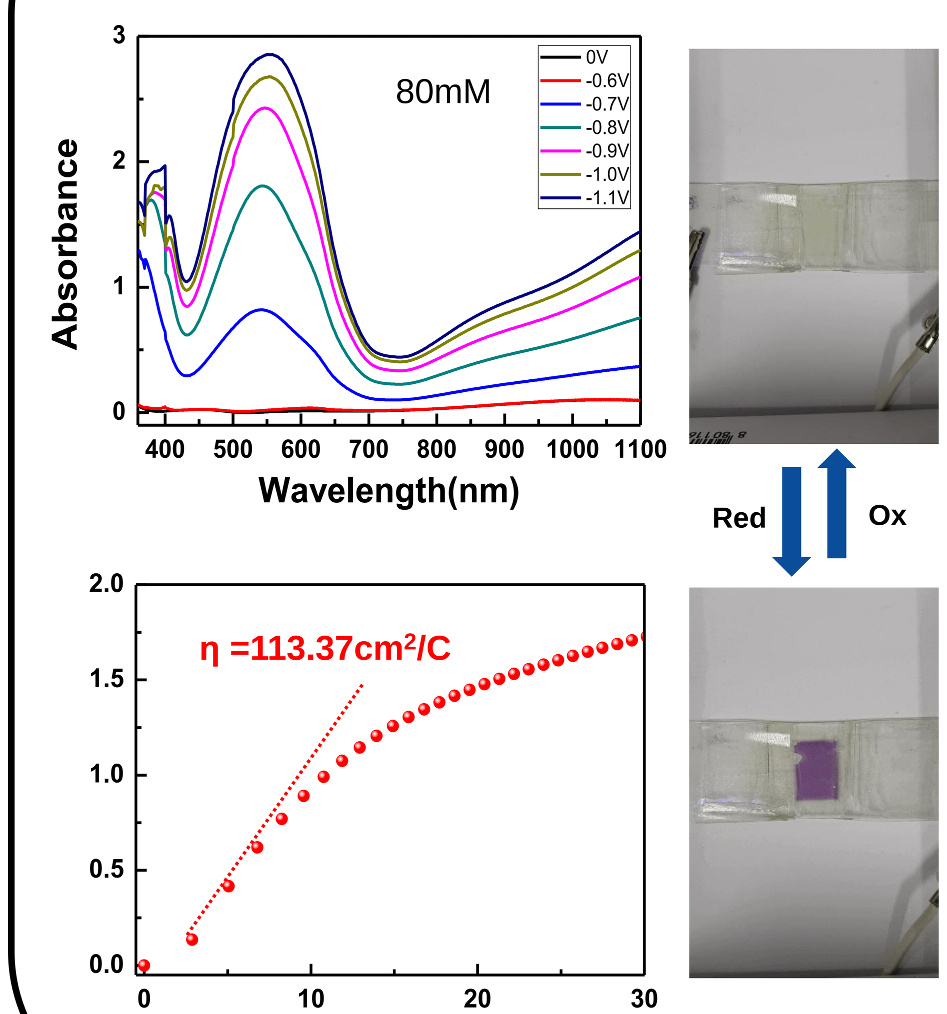
1. Dynamics



2. CV



3. Color characteristic



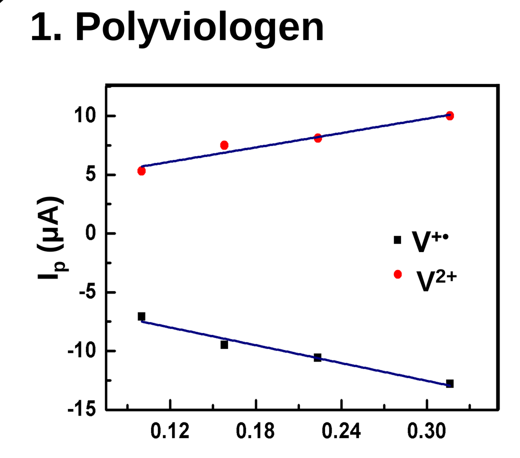
Diffusion Coefficient

Randles-Sevcik Eq.

$$i_p = 0.4463 * n * F * A * C * \left(\frac{nFvD}{RT}\right)^{0.5}$$

- i_p = current maximum in amps
- n = number of electrons transferred in the redox event (usually 1)
- A = electrode area in cm²
- F = Faraday Constant in C mol⁻¹
- **D = diffusion coefficient in cm²/s**
- C = concentration in mol/cm³
- v = scan rate in V/s
- R = Gas constant in J K⁻¹ mol⁻¹
- T = temperature in K

1. Polyviologen



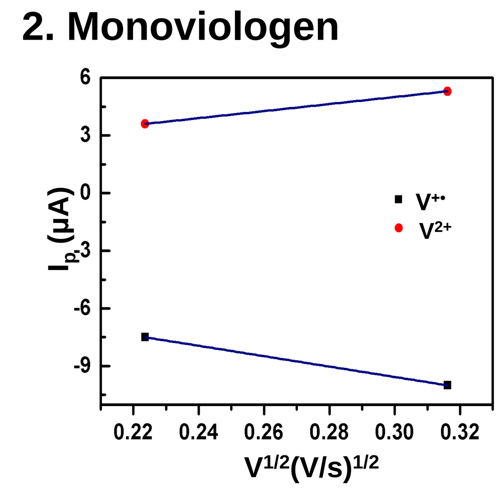
Randles-Sevcik Eq at 25℃

$$D = \frac{(i_p^2/v)}{(268,600^2 n^3 A^2 C^2)}$$

n = 25
A = 7.84×10^{-3} cm²
C = 3.2×10^{-6} mol/cm³

$D_a = 7.047 \times 10^{-10}$ cm²/s
$D_c = 8.071 \times 10^{-10}$ cm²/s

2. Monoviologen



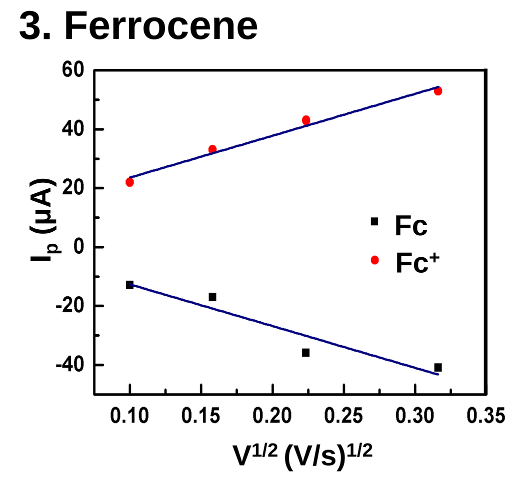
Randles-Sevcik Eq at 25℃

$$D = \frac{(i_p^2/v)}{(268,600^2 n^3 A^2 C^2)}$$

n = 1
A = 7.854×10^{-3} cm²
C = 8×10^{-5} mol/cm³

$D_a = 1.183 \times 10^{-8}$ cm²/s
$D_c = 2.558 \times 10^{-8}$ cm²/s

3. Ferrocene



Randles-Sevcik Eq at 25℃

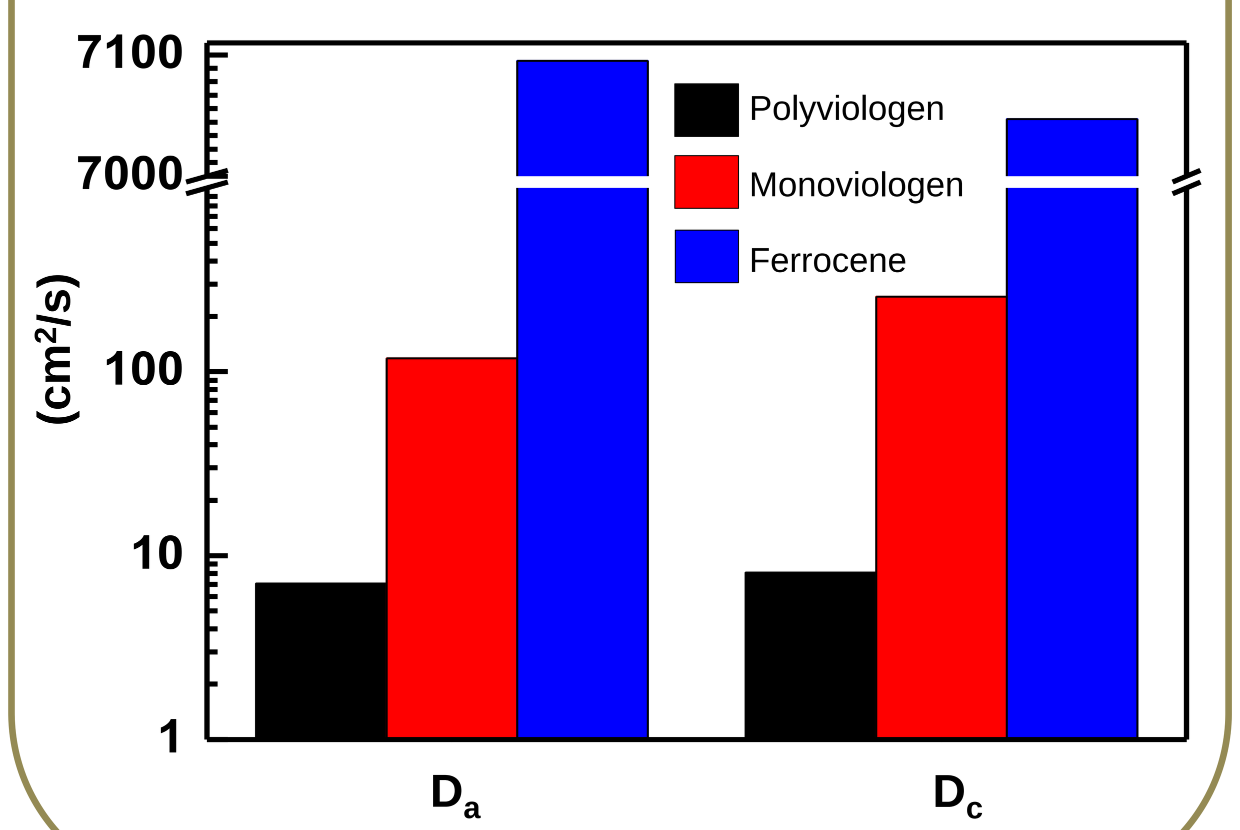
$$D = \frac{(i_p^2/v)}{(268,600^2 n^3 A^2 C^2)}$$

n = 1
A = 7.854×10^{-3} cm²
C = 8×10^{-4} mol/cm³

$D_a = 7.095 \times 10^{-7}$ cm²/s
$D_c = 7.047 \times 10^{-7}$ cm²/s

Conclusion

Diffusion coefficient



Summary

- We proposed a simple yet highly effective supercapacitor using polyviologen.
- Electrochemical and electrochromic properties of polyviologen were verified using dynamics, cyclic voltammetry and UV/vis spectroscopy.
- Polyviologen was suitable for supercapacitor due to smaller diffusion coefficient than that of monoviologen.
- In order to improve the performance of supercapacitor, an anodic species with a small diffusion coefficient should be developed.