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Research Scholarship for Overseas Students

Development of Nanofillers Based Gel-Polymer Electrolyte for Efficient Electrochromic Devices

Gaurav Kumar Silori and Kuo-Chuan Ho

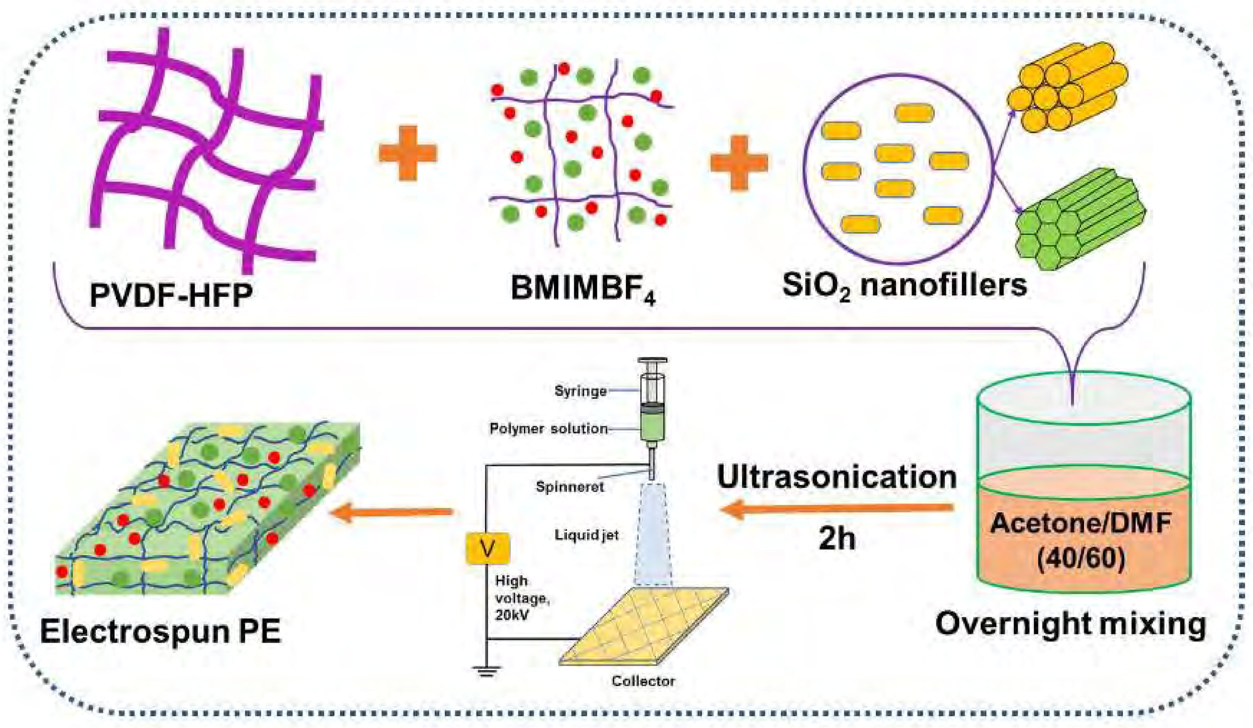
Department of Chemical Engineering

National Taiwan University, Taipei, 106319, Taiwan

*Email: kcho@ntu.edu.tw

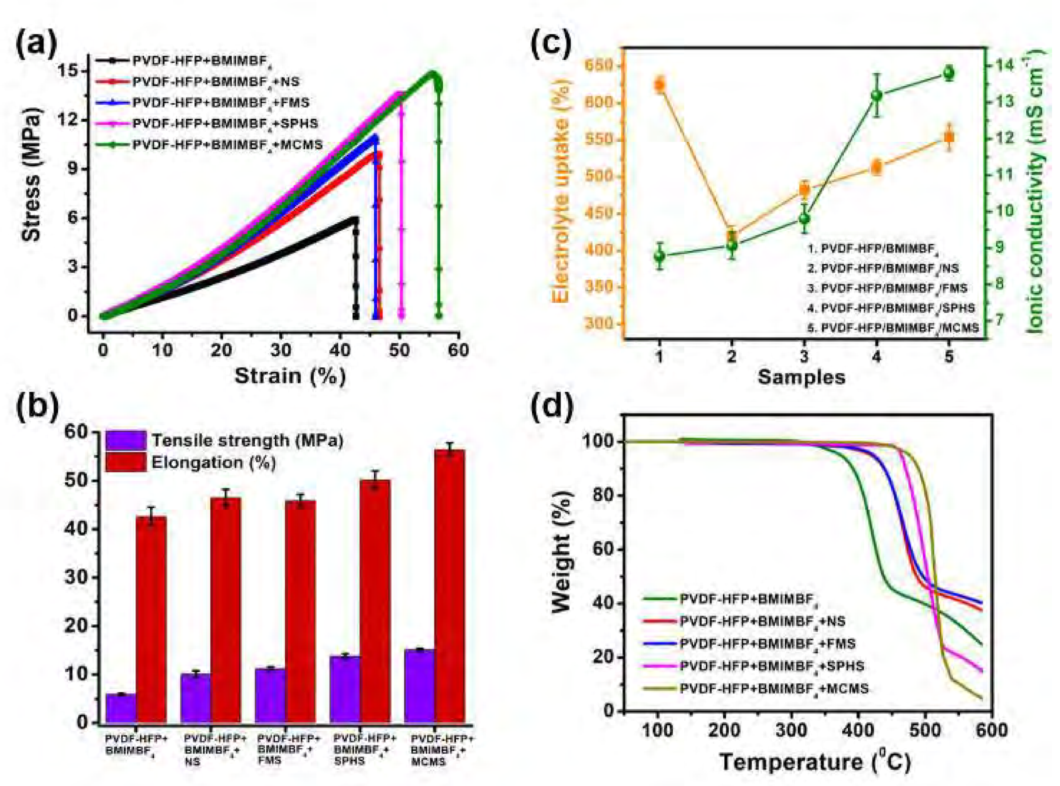
INTRODUCTION

- Nanofillers' applicability in GPE based electrochromic devices (ECDs) has hardly seen any development due to challenges such as optical inhomogeneity brought by incompetent nanofiller sizes, transmittance drop due to higher filler loading (usually required), and poor methodologies of electrolyte fabrication.
- To address such issues, we demonstrate a reinforced polymer electrolyte tailored through poly(vinylidene fluoride-*co*-hexafluoropropylene) (PVDF-HFP),1-butyl-3-methylimidazolium tetrafluoroborate ($BMIMBF_4$) and four types of mesoporous SiO_2 nanofillers; porous (distinct morphologies) and non-porous, two each.
- fine nano-silica, fumed silica, spherical pore type silica, and hexagonal pore type silica in this study were abbreviated as NS, FMS, SPHS, and MCMS, respectively.



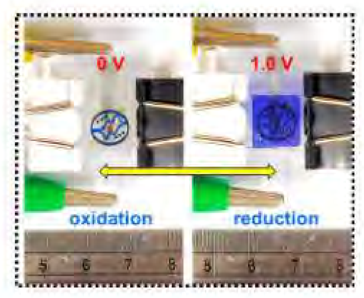
RESULTS: PHYSICAL CHARACTERIZATION

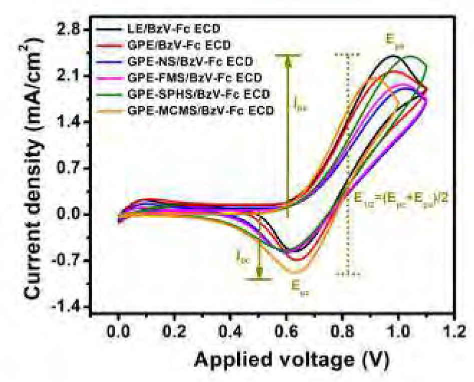
- The requirement of enhanced mechanical strength was one of the prime reasons behind nanofiller's doping into GPEs.
- The advantages of filler incorporation in GPE were perceived through the astounding enhancement in tensile strength (up to 156%) and elongation (up to 36%).
- The SPHS- and MCMS-based GPE unveiled ideal room temperature ionic conductivities of ~13.1 and ~13.8 mS cm^{-1}, respectively.
- An increment of ~23% was seen in the thermal stability of MCMS-based GPE compared to the filler-less counterpart.

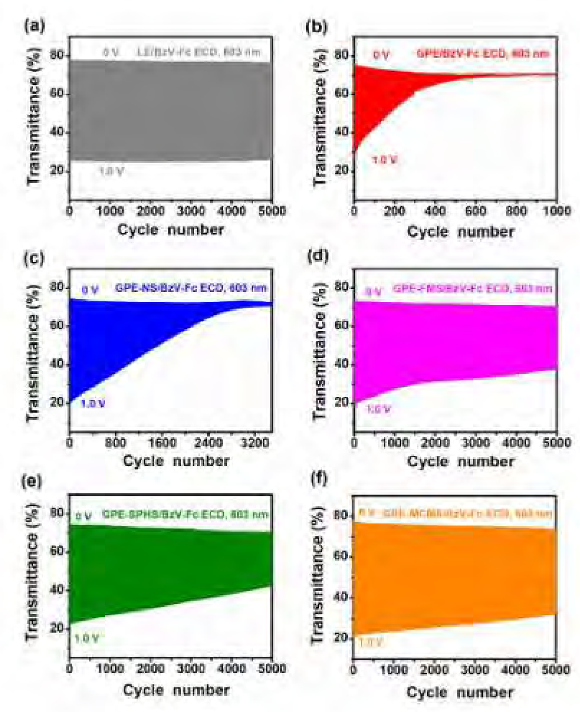


RESULTS: ELECTRO-OPTICAL CHARACTERIZATION

- Nanofillers with morphological features rendered noticeable electrochemical improvements in GPE-based ECDs.
- High surface-to-volume ratio of porous nanofillers provided enhanced interactions for redox switching, resulting in improved bleached and color state transmission.
- The remarkably improved switching of MCMS-based ECD was attributed to the lowest charge transfer resistance, high electrolyte retention of GPE, and superior interface adhesion during the cycling process.

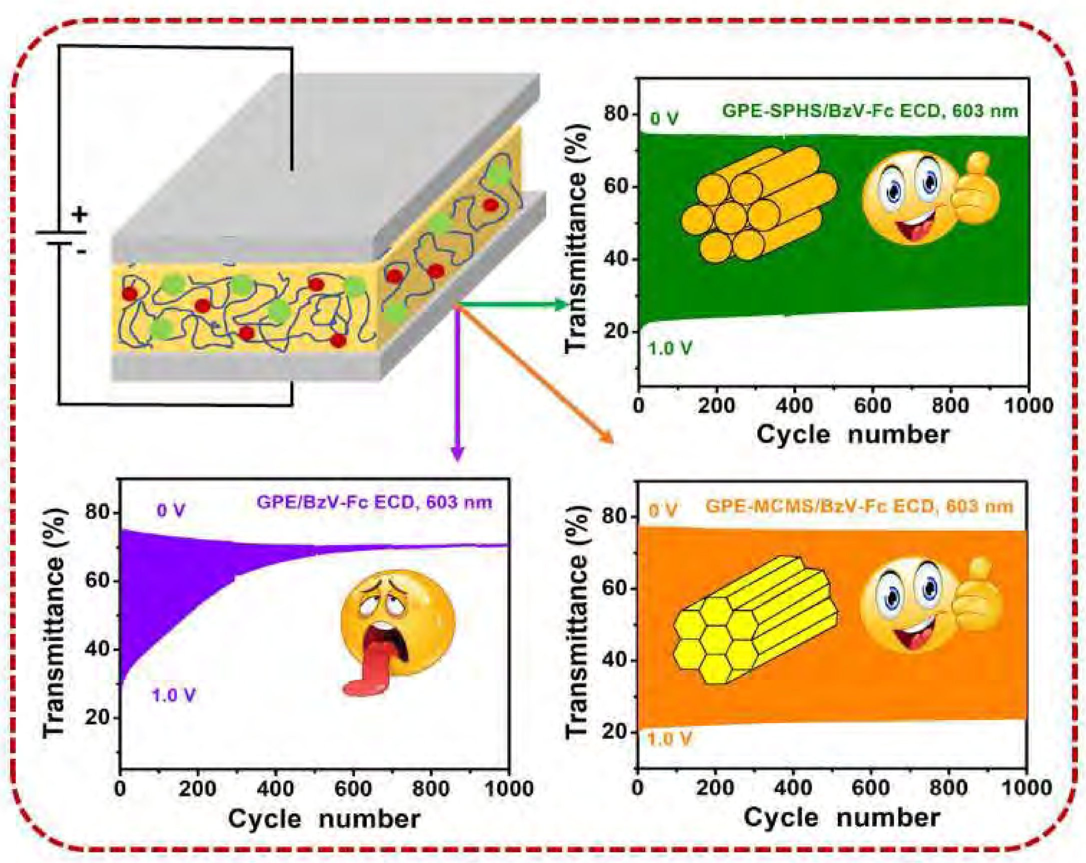






CONCLUSIONS

- Structured porous morphology of mesoporous nanofillers mounts a superior class of GPE, which could address issues such as higher filler loading requirement, low ionic conductivity, sluggish response time, and poor switching stability in GPE-based ECDs.



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