Development of various functional hydrogels of imidazolium-based zwitterionic polymers

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Zwitterionic polymers (ZPs), which have anionic and cationic parts in the same monomer unit, have received enormous attention because of their promising properties, such as stimuli-responsiveness, remarkable hydrophilicity, and the anti-polyelectrolyte effect. Zwitterions have a higher dipole moment than other electrically neutral molecules because the cationic and anionic parts are connected by organic linkers, which restricts the distance between them. This results in remarkable ion–dipole or dipole–dipole interaction between ZPs and other molecules. Generally, polyelectrolytes (PEs), which have a net charge, have a stretched chain conformation in pure water but take on a collapsed conformation in salt solutions because of the screened electrostatic repulsion between or within the PE. This is called the polyelectrolyte effect. On the other hand, ZPs are known to show an anti-polyelectrolyte effect, in which the polymer becomes much more soluble in the salt solution, but this is highly dependent on the nature of the ZP, temperature, and concentrations of salt and ZPs. Among the common zwitterionic monomers for synthesizing ZPs, sulfobetaine methacrylate (SBMA) with quaternary ammonium and sulfonate groups, which is commercially available, is a widely used monomer for ZP synthesis. Recently, sulfobetaines based on vinyl pyridine (SBVP) and vinyl imidazole (SBVI) monomers suitable for radical polymerization have also been developed. In particular, the imidazolium cation is distinct from the ammonium cation because its positive charge is delocalized in a five-membered aromatic ring, and it can form non-covalent interactions with other molecules, including π-π, cation-π, and anion-π interactions.

Here, we newly fabricated physically cross-linked graphene hydrogels through cation-π interaction with zwitterionic imidazolium-based polymers. We established facile and novel synthetic methods for fabricating graphene hydrogels by using microwave irradiation which induces exfoliation of graphite and polymerization simultaneously.

In this presentation, extremely simple method to fabricating graphene hydrogels and their electrochemical performances, adhesive, reusable, and robustness properties will be discussed.

[Reference] I. K. Han, J. Han, Y. S. Kim* “Liquid-to-Solid Phase Transitions of Imidazolium-Based Zwitterionic Polymers Induced by Hofmeister Anions”, *Chem Asian J.* **2021,** *16*, 1– 5.