SOMO Design of Radical Polymers for Development of Fully Organic Rechargeable Batteries

Hiroyuki Nishide
(Waseda University, Department of Applied Chemistry, Professor)

【Outline of survey】

Based on the chemical stability of nitroxide radicals under ambient conditions and their electrocemical reversibility, prototypes of fully organic batteries have successfully been fabricated using p-type and n-type radical redox polymers as electroactive materials for cathodes and anodes, respectively. The present research aims at developing radical polymers bearing stable redox sites with ultimate density designed for well-balanced SOMO energy levels and unpaired electron delocalization, based on the establishment of organic radical-related electrochemistry. The research also expects to accomplish rapid electron transfer process within polymer membranes, based on the elucidation of mass-transfer process accompanied by the redox reaction for minimization of electrical resistance. These basic aspects of research will be accumulated with a view to fabricate next-generation rechargeable batteries.

【Expected results】

The research is expected to provide new insights into the electro-organic chemistry featuring organic stable radicals, and novel methods of SOMO engineering to allow optimization of redox potentials and energy densities based on the control of SOMO levels and orbital interactions of radical polymers. The present approach is potentiality capable of producing high power-capacity batteries exceeding those of lithium-based batteries. The organic battery is advantageous in handling use over those conventional batteries, in terms of safety, flexibility and disposability.

【References by the principal investigator】

- Photocrosslinked Nitroxide Polymer Cathode-Active Materials for Application in an Organic-Based Paper Battery, T. Suga, H. Konishi, H. Nishide, *Chem. Commun.*, **17**, 1730-1732 (2007).
- Cathode- and Anode-Active Poly(nitroxylstyrene)s for Rechargeable Batteries: p- and n-Type Redox Switching via Substituent Effects, T. Suga, Y.-J. Pu, S. Kasatori, H. Nishide, *Macromolecules*, **40**, 3167-3173 (2007).
- Room-Temperature High-spin Organic Single Molecule: Nanometer-Sized and Hyperbranched Poly[1,2,(4)-phenylenevinyleneanisylaminium], E. Fukuzaki, H. Nishide, *J. Am. Chem. Soc.*, **128**, 996-1001 (2006).

【Term of project】 FY2007－2011	【Budget allocation】 24,000,000 yen （2007 direct cost）

【Homepage address】 http://www.appchem.waseda.ac.jp/~polymer/index.html