

Flexible all-solid electrochemical capacitors composed of inorganic nanosheets

Masaru Miyayama
University of Tokyo, Japan

Protonic electrochemical capacitors using oxide electrodes and aqueous electrolyte is a promising candidate for the energy storage device with high energy & power densities and reliable safety. The use of solid electrolytes in place of aqueous solutions enables to fabricate thin-film type electrochemical capacitors, and it is expected to apply them for various portable devices. "Nanosheets" are plate-like particles with thickness of only a few nanometers, and are prepared by delamination of layer-structured compounds. We found that thin films prepared by restacking of nanosheets have excellent bending durability. Namely, their conductivities are kept almost unchanged under bending deformation. Electrochemical capacitors were assembled with thin-film electrodes of RuO_2 and/or $\text{Hx}(\text{Ni}, \text{Co}, \text{Mn})\text{O}_2$ and an electrolyte layer of LDH (layered Mg-Al double hydroxide). These capacitors showed reversible capacities even under bending with a curvature radius of 3 mm. Such flexible electrochemical capacitors are expected to be applied as thin-film energy storage devices for wearable and miniaturized electronic devices. In the talk, mechanisms of the bending durability and effects of electrode configuration are also described.

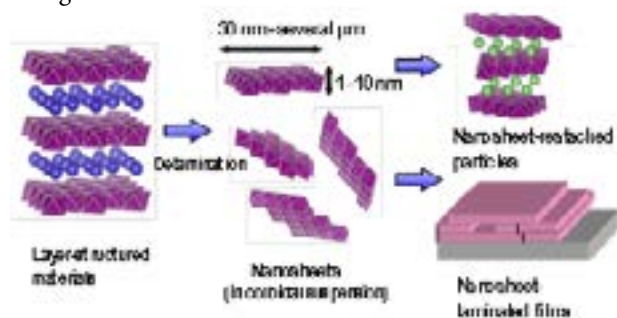


Figure: Nanosheet process: delamination and restacking to particles and thin films.

Recent Publications

- M Yano, S Suzuki, M Miyayama and M Ohgaki (2013) Effects of microstructure on electrode properties of nanosheet-derived $\text{Hx}(\text{Ni}1/3\text{Co}1/3\text{Mn}1/3)\text{O}_2$ for Electrochemical capacitors. *Nanomaterials*. 3(2):204-220.
- M Yano, S Suzuki, M Miyayama and M Ohgaki (2013) Electrochemical properties of layer-structured $\text{Hx}(\text{Ni}1/3\text{Co}1/3\text{Mn}1/3)\text{O}_2$ for electrochemical capacitors in alkaline aqueous solutions. *J. Asian Ceram. Soc.* 1(1):71-76.
- K Kamei, S Suzuki and M Miyayama (2014) Electrical properties of V_2O_5 /carbon composite electrodes in aqueous solutions. *J. Mater. Sci.* 49(16):5579-5585.
- W Lee, S Suzuki and M Miyayama (2014) Electrode properties of defect-introduced graphene sheets for electrochemical capacitors using aqueous electrolyte. *Electrochim. Acta.* 142:240-246.
- H Jang, S Suzuki and M Miyayama (2014) The role of Cu ions of the self-reassembled MnO_2 nanosheets for rechargeable aqueous batteries. *J. European Ceram. Soc.* 34(16):4297-4304.

Biography

Masaru Miyayama is a Professor of Department of Applied Chemistry, School of Engineering, The University of Tokyo. He got his Bachelor's in Engineering in 1977 and Master's in Engineering in 1979 on Inorganic Materials Chemistry, and Doctor's degree in 1987 on Functional Ceramic Materials, all from The University of Tokyo. He started to work as a Research Associate in 1979, and was promoted to a Full Professor of The University of Tokyo in 2001. His research interests include ferroelectric, conducting and electrochemical properties of oxide-based materials, and materials design through nanostructure control and defect engineering. He is a Fellow of The Ceramic Society of Japan.

miyayama@fmat.t.u-tokyo.ac.jp