Towards Electrochemical Artificial Muscles: A Supramolecular Machine Based on One-dimensional Copper-containing Organophosphonate System

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The development of artificial system is a field which is currently being intensively explored. In particular, interest is being focused on transition-metal-containing system. In our laboratory, we have created a new supramolecular machine, exhibited reversible electromechanical actuators based on sheets of water-soluble one-dimensional copper-centred enthylenephosphonate (1DOP-Cu) chains, described for the first time. Like natural muscles, the macroscopic sheet actuators are composed of mats of individual nanofiber bundles joined by mechanical entanglement and pi-pi interaction forces along the crystallographic a-axis. The lithium inserted state, upon electrochemical charge injection into 1DOP-Cu, exhibits a reversible contraction/ stretched process by oxidizing or reducing the copper center to Cu(II) or Cu(I) whose coordinated geometries will be changed at will by a redox process, as characterized by x-ray diffraction patterns, solid state NMR, and XANE spectra.

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