# Takuzo Aida

Dept. of Chem. and Biotech., The University of Tokyo, Japan

Friday, October 29, 2021 | ZOOM | 10:00 AM (ET)

**Title | Supramolecular Polymerization: Its Significance and Applications**

**Abstract |** About a century ago, Dr. Hermann Staudinger substantiated the existence of ultralong molecules and won the long- term debate against the colloidal theory to establish polymer science. Needless to say, polymer science has made tremendous contributions to the progress of human society, although it coincidentally brought about a critical environmental issue to tackle. In this lecture, I would like to present the significance and applications of supramolecular polymerization, a modernized version of the colloidal approach to polymeric materials. Supramolecular polymers attract attention not only because they are 100% recyclable but also they can be designed to be environmentally friendly, self-healable, responsive, and/or adaptive [1–4]. In 1988, we reported the first prototype of supramolecular polymerization, featuring the formation of a 1D polymeric assembly using an amphiphilic porphyrin with water-soluble oligoether side chains as the monomer and have made fundamental contributions to this field [5]. Representative examples include (1) nanotubular supramolecular polymerization, (2) chain-growth supramolecular polymerization, (3) supramolecular block copolymerization, (4) stereoselective supramolecular polymerization, and (5) thermally bisignate supramolecular polymerization. These contributions are integral elements of conventional polymer science, filling in the critical gap between supramolecular and conventional polymerizations. Furthermore, we have expanded the basic concept of supramolecular polymerization into the noncovalent design of innovative soft materials. Successful examples include the developments of (i) bucky gels, (ii) aquamaterials, (iii) mechanically robust self-healable materials, (iv) supramolecular polymers of biomolecular machines, (v) ferroelectric columnar liquid crystals, and (vi) reorganizable and adaptive core- shell columnar liquid crystals. I will highlight some of these examples to show the significance of supramolecular polymerization for the realization of sustainable society [6–8].

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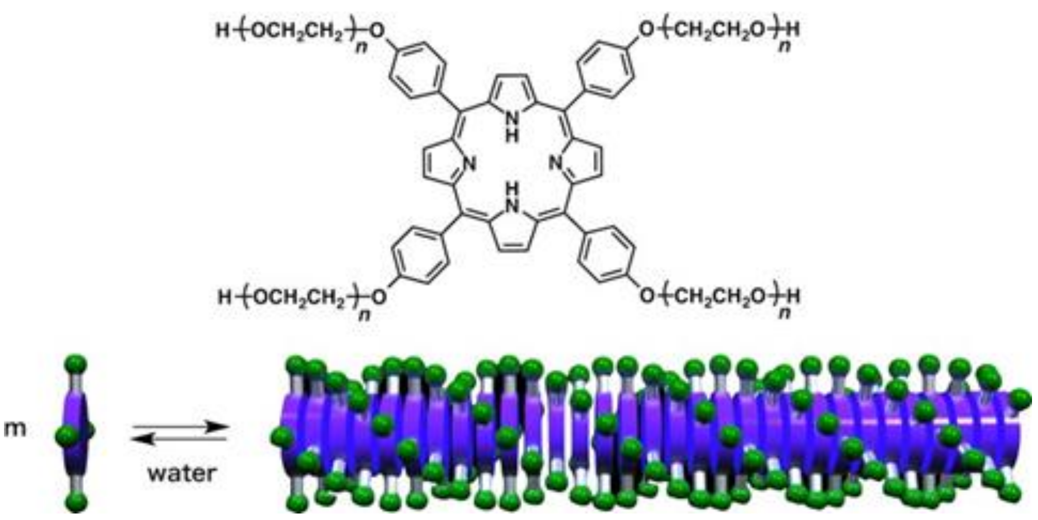

**CV |** Takuzo Aida

Department of Chemistry and Biotechnology, School of Engineering, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan.

**Education:**
BS: Faculty of Engineering, Yokohama National University (1979) MS: School of Engineering, The University of Tokyo (1981) PhD: School of Engineering, The University of Tokyo (1984)

1984–1989: Assistant Professor, The University of Tokyo 1989–1991: Lecturer, The University of Tokyo 1991–1996: Associate Professor, The University of Tokyo 1996–Now: Professor, The University of Tokyo
1996–1999: Researcher, Japan Science & Technology Agency, PRESTO Project
2000–2005: Director, Japan Science & Technology Agency, ERATO Nanospace Project 2005–2010: Director, Japan Science & Technology Agency, EARTO–SORST Project on Electronic Nanospace
2008–2012: Director, RIKEN Advanced Science Institute
2013–2013 Deputy Director, Riken Center for Emergent Matter Science 2004–2006: Associate Editor, Journal of Materials Chemistry (RSC) 2009– Board of Reviewing Editors, Science Magazine (AAAS)
2014– Advisory Board, Journal of the American Chemical Society (ACS)

**Selected Awards:**
American Chemical Society Award in Polymer Chemistry (2009) / Chemical Society of Japan Award (2009) / Purple Ribbon (2010) / Alexander von Humboldt Research Award (2011) / Fujiwara Prize (2011) / Leo Esaki Prize (2015) / Dean Award, U. Tokyo (2016), Chirality Medal (2017), Japan Academy Prize (2018), The Ichimura Prize in Science for Excellent Achievement (2020), Ryoji Noyori ACES Award (2020), Member of the Royal Netherlands Academy of Arts and Science (2020), Member of the US National Academy of Engineering (2021). / The Netherlands Award for Supramolecular Chemistry (2021).

**Selected Recent Publications:**
(1) An Elastic Metal–Organic Crystal with a Densely Catenated Backbone, Nature 2021, in press.
(2) Solvent-Free Autocatalytic Supramolecular Polymerization, Nature Mat. 2021, in press.
(3) Nematic-to-Columnar Mesophase Transition by in situ Supramolecular Polymerization, Science 2019, 363, 161–165.
(4) Self-Assembly of Lattices with High Structural Complexity from a Geometrically Simple Molecule, Science 2018, 361, 1242–1246.
(5) Mechanically Robust, Readily Reparable Polymers via Tailored Noncovalent Cross-linking, Science 2018, 359, 72–76.
(6) Thermally Bisignate Supramolecular Polymerization, Nature Chem. 2017, 9, 1133–1139.
(7) An Autonomous Actuator Driven by Fluctuations in Ambient Humidity, Nature Mat. 2016, 14, 1084–1089.
(8) Sub-Nanoscale Hydrophobic Modulation of Salt Bridges in Aqueous Media, Science 2015, 348, 555–559.
(9) Selective-Assemblies of Giant Tetrahedra via Precisely Controlled Positional Interactions, Science 2015, 348, 424–428.
(10) A Rational Strategy for the Realization of ‘Chain-Growth’ Supramolecular Polymerization, Science 2015, 347, 646–651.
(11) Ultrahigh-throughput Exfoliation of Graphite into Pristine ‘Single-Layer’ Graphene Using Microwaves and Molecularly Engineered Ionic Liquids, Nature Chem. 2015, 7, 730–736.
(12) Anisotropic Hydrogel with Embedded Electrostatic Repulsion among Cofacially Oriented 2D Electrolytes, Nature 2015, 517, 68–72.
(13) Manipulation of Discrete Nanostructures by Selective Modulation of Noncovalent Forces, Science 2014, 344, 499–504.

**Contact |** Prof. Ali Nazemi <nazemi.ali@uqam.ca>