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Oxide cluster-surfactant hybrid single crystals toward solid electrolyte

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To synthesize highly conductive materials is crucial for lithium-ion or fuel-cell battery technology due to their structural stability and easiness for handling. A promising strategy is to hybridize inorganic and organic molecular components and to construct crystalline layered structures beneficial to the emergence of conductive property. Polyoxometalate oxide cluster anions having characteristic redox properties are suitable as inorganic components. Polyoxometalates can be hybridized with cationic surfactants to form stable layered single crystals. Such ionic crystals are rare, and both polyoxometalate and surfactant components can be variously selected to build up functional inorganic-organic hybrid crystals. The polyoxometalate-surfactant hybrid crystals were synthesized by cation-exchange reaction with pH-adjusted solutions of molybdate, tungstate, and vanadate oxoanions. Single crystals were obtained from the filtrate solutions or by recrystallization of the crude precipitates, and subjected to X-ray structure analyses. Decatungstate and tetra-molybdate anions formed stable single crystals together with hexadecylpyridinium. The crystals exhibited the alternate stacking of polyoxometalate inorganic layers and surfactant organic layers. The obtained conductivity values were in the range of 10^{-6} to 10^{-5} S cm^{-1} order over 423° K under anhydrous atmosphere. Decavanadate anion formed layered crystals with alkyltrimethylammonium. The hybrid crystals which comprise diprotonated decavanadate species exhibited anhydrous proton conductivity at intermediate temperatures (>373° K), which is possible for proton-conducting electrolyte of fuel cells.

Biography

Takeru Ito has received his Doctor's degree in 2001 at the University of Tokyo. After his Post-doctoral studies from the University of Tokyo and Tokyo Institute of Technology, he was appointed as an Assistant Professor at the Tokyo Institute of Technology. He moved to Tokai University in 2008, and now he is an Associate Professor. His research interests are focused on the synthesis and functionalization of Polyoxometalate Surfactant Hybrid Crystals.

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