JST- CREST Research Project　Oct., 2012 – Mar., 2017

“Innovative Applications to Harness the Novel Functions of Nano-scaled Iron Oxides of Microbial Origin”

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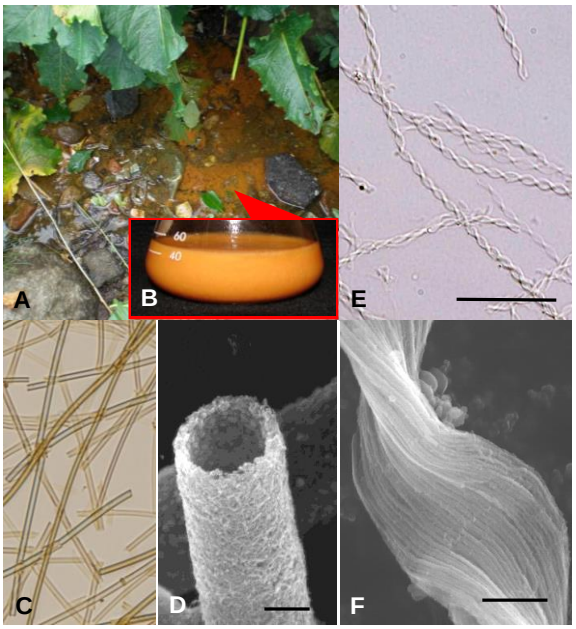
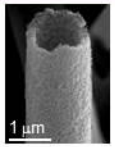
Iron-oxidizing bacteria ubiquitously produce extracellular, uniquely shaped microsheaths or ribbon-like, fibrous bundles (Fig.1 C-D and E-F) primarily of iron oxides in natural hydrosphere (Fig. 1 A and B). Although this biogenous iron oxide [BIOX] generally has been treated as waste, we assumed that it has undiscovered industry-worthy functions. In careful, rigorous studies, we discovered that the BIOX matrix has an amorphous state; an organic-inorganic hybrid state of primary particles (ca. 3nm diameter); Fe, Si, P as major elements linked via oxygen; and extremely noteworthy, diverse, commercial functions (e.g., great potential as an anode for Li-ion batteries, high affinity to human cells) far surpassing those of artificial iron oxides. To fully harness these functions for broad industrial applications, this collaborative study encompassed material science, microbiology, electrochemistry, biotechnology with high hopes and expectations for developing this eco-friendly, nontoxic, low-cost, fascinating BIOX into beneficial materials for the next generation. This project in JST-CREST （Core Research for Evolutional Science and Technology） program is proceeding by collaboration of Okayama, Kyoto, and Mie Universities for 4.5 years from Oct. 2012.



JST-CREST Research Project

Past Achievement

Iron oxides of bacterial origin



Characters

- Microtubular shape
- Nanoscale primary particles (~3 nm diameter)
- Major elements present (Fe, Si, P, O, H, C)
- Amorphous matrix
- Organic–inorganic hybrid

Research Target

☆**Character alteration**
- Chemical components
- Primary nanoscale structure

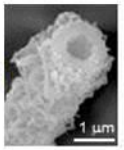
☆**Function upgrade**

Iron Oxides Produced by Bacterial Culture

Artificial culture of isolated Fe-oxidizing bacteria

Creation of novel eco-friendly functional materials

Alter culture conditions

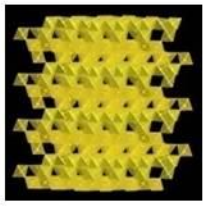


☆ **Artificially altered**
① Chemical components
② Nanoscale structure

Synthetic Iron Oxides

Regular Iron Oxide

Altered Iron Oxides



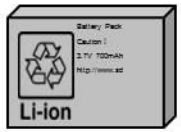
Substitute elements

☆**Artificially altered**
① Chemical components
② Nanoscale structure

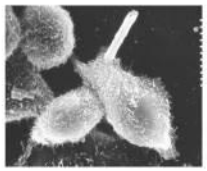
Multi-disciplinary approach

Creation of Innovative Functions

- **Novel electrode for Li ion rechargeable battery**



- **High affinity with human cells → Cell culture**



- **Efficient catalysts**
- **High grade pigments**