● FY2013 Jun Takada （Professor, Okayama University）

Toward Creating Innovative Applications to Harness the Novel Functions of Nano-scaled Iron Oxides of Microbial Origin

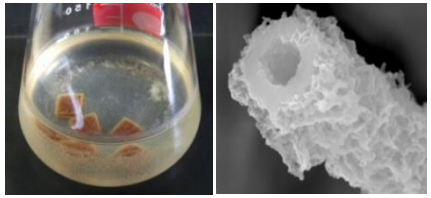
Research Project Outline (From Oct. 2012 to Mar. 2017)

Structural and functional analyses of unique iron oxides of bacterial origin , BIOX, and their mimic iron oxides artificially synthesized

◎ Iron oxides produced by bacterial culture: Creation of novel nano-scaled iron oxides by artificial culture of isolated Fe-oxidizing bacterium (strain OUMS1) under altered culture conditions

◎ Synthetic iron oxides: Creation of novel nano-scaled low-cyrstalline iron oxides by adjusted preparation of chemicals in reference to chemical characters of the bacterial product

→Toward creation of novel eco-friendly innovative functional materials [e.g., great potential as electrode of Li ion rechargeable battery, high affinity to human cells, efficient catalytic potential, high grade pigment etc.]



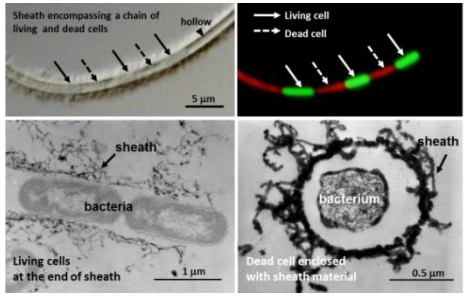
Iron oxides produced by bacterial culture

Research Results (FY2013)

◆ Hollowing Mechanism in BIOX Sheaths

- ✓ We challenged the query why most of sheaths harvested from natural environments are hollow in spite of involvement of the bacterium in sheath formation.
- ✓ The initial bacterial growth and associated sheath formation was observed by microscopy.
- ✓ The bacterium (OUMS1) repeats cell division at both elongating ends of sheath. However, at intra-sheath the cells enclosed with Fe-, Si-, and P-encrusted sheath materials lose viability and result in subsequent autolysis, leaving the hollow sheaths

Minerals, 3, 247-257 (2013)

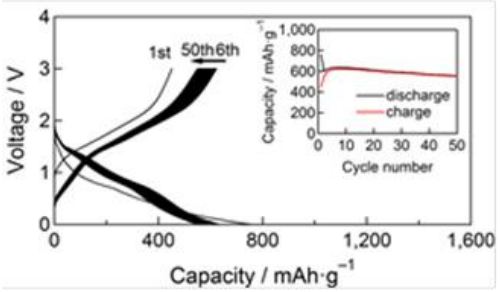


Cell death at intra-sheath space

◆ Potential as a Lithium-Ion Battery Anode Material

- ✓The charge-discharge properties of simple *L*-BIOX/Li-metal cells were examined at current rates of 33.3mA/g (0.05C) and 666mA/g (1C).
- ✓*L*-BIOX has been found to exhibit a high potential as an Fe^{3+}/Fe^{0} conversion anode material with a high capacity (significantly higher than those of conventional carbon materials) and a good cyclability at high current rates.
- ✓Since the Fe-based electrochemical centers are embedded in a Si/P-based amorphous texture, undesirable coagulation of the Fe-centers is prevented.

ACS Appl. Mater. Interfaces, 6, 5374-5378 (2014)



Charge-discharge curves at 666 mA/g and the cycle-life performance.