● FY2015 Jun Takada （Professor, Okayama University）

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

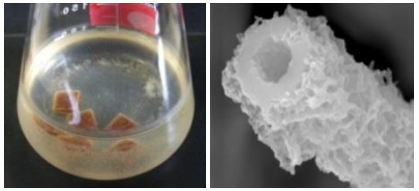
Research Project Outline (From Oct. 2012 to Mar. 2018)

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 Fe oxides by culture of an isolated Fe-oxidizing bacterium (*Leptothrix* sp. 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 available for 3D culture, efficient catalytic potential, high grade pigment (glaze), plant protectant, etc.]



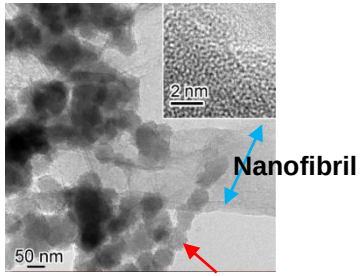
Iron oxides produced by bacterial culture

Research Results (FY2015)

◆Unexpected mode of Fe encrustation of *Leptothrix* sheaths in culture

✓ Fe encrustation of *Leptothrix* sheaths was previously believed to occur by interactions of active groups in organic sheath materials excreted from bacterial cells with aqueous-phase Fe in hydrosphere and/or involvement of cellular Fe oxidase in conversion from Fe(II) to Fe(III).

✓ Our recent studies proved that in culture conditions, Fe(II) in medium was promptly oxidized to form Fe(III) particles which then directly attached surfaces of the existing immature sheaths, resulting in Fe-encrusted sheaths. We proposed that such a direct attachment of Fe(III) particles could account for another mode of Fe encrustation in addition to the past proposed mechanisms.

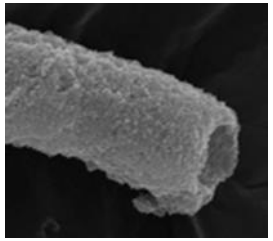


Fe(III) particle

◆ Successful creation of novel Fe oxide microtubules containing varied amounts of Al

✓ L-BIOX harvested from natural environments has nearly constant chemical components, crystallinity, nanostructure, and its functions. Referring these fundamental characters, we expected to create novel functional materials: Fe oxide microtubules containing varied amounts of Al.

✓ We contrived the new methods to create such complexes: First, the immature sheaths with no Fe encrustation were formed in culture, and second, these sheaths were treated with solutions containing varied amounts of Fe and Al, This two step method successfully achieved the expected results. Crystallinity of the products was regulated by modification of Fe/Al ratio in medium. This unique method may lead to creation of novel functional materials containing other diverse metallic or nonmetallic elements.



SEM image of Fe oxide microtubule containing ~0.35 Al