

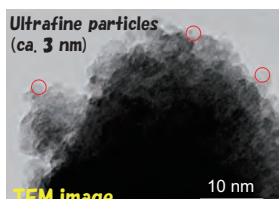
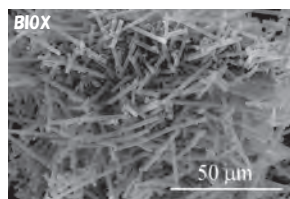
# Amorphous Iron Oxide Nanoparticles of Bacterial Origin and Their Application to Immobilized Catalysts

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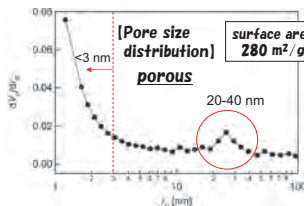
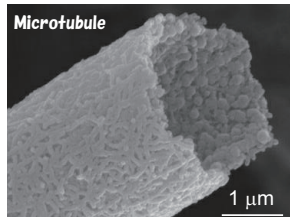
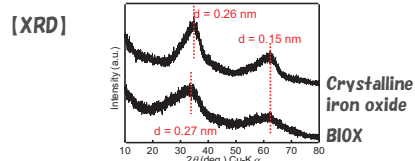
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## [Biogenous iron oxide (BIOX) produced by iron-oxidizing bacteria]

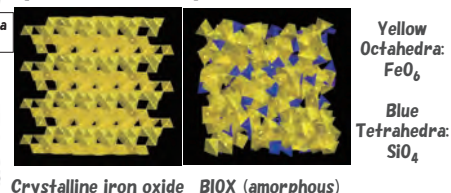
Unique features : Nano-particles, Porous, Amorphous



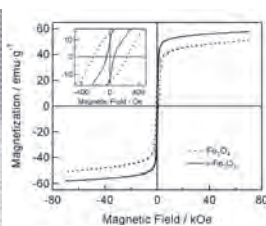
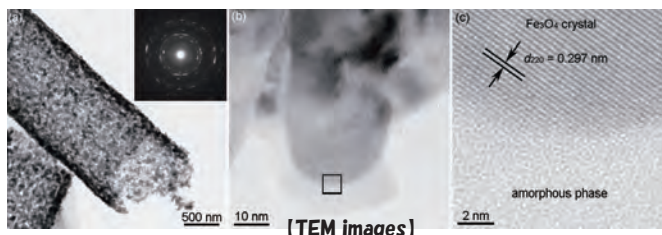
Amorphous structure (atomic arrangement is random)



[Structural model]



Unique capabilities : e.g. magnetization by simple heat-treatment

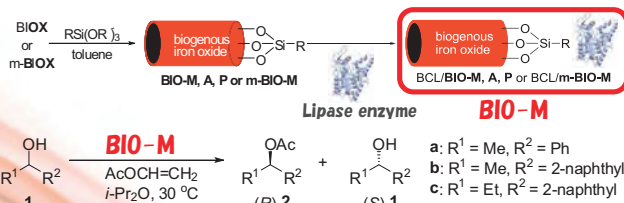


BIOX has infinite possibilities as an advanced material !!

- ☆unique features
- ☆enormous capabilities
- ☆ubiquitous
- ☆eco-friendly
- ☆harmless
- ☆cost-effective

## [Application Examples : In Applied Chemistry]

### 1. Lipase immobilized BIOX (BIO-M)



entry	support	1	time (h)	conv. (%)	% yield (% ee)		E value	TTN	TOF
					(R)-2	(S)-1			
1	BIO-M	1a	1	46	23 (98)	31 (83)	>200	33,000	33,000*
2	m-BIO-M	1a	2.5	47	40 (>99)	48 (89)	>200	34,000	13,000
3	γ-Fe <sub>2</sub> O <sub>3</sub> -M	1a	6	31	31 (>99)	69 (45)	>200	22,000	3,700

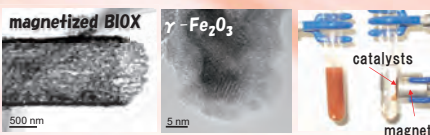
Ema, T. et al., Green Chem. 13, 3187-3195 (2011).

\*BIO-M is a highly efficient catalyst !!

Further more,

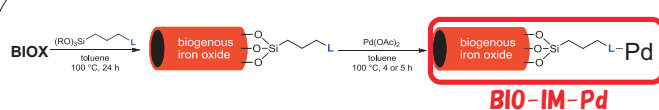
BIO-M showed incredible catalytic activity almost 20-fold greater than commercially available immobilized catalyst (Toyonite-200M).

Industrial application :  
Chemical modification of magnetized BIOX

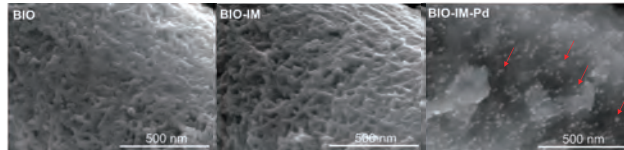


Use of high active catalysts and magnetic separation techniques  
⇒ Simplifies chemical engineering processes !!

### 2. Pd immobilized BIOX (BIO-IM-Pd)



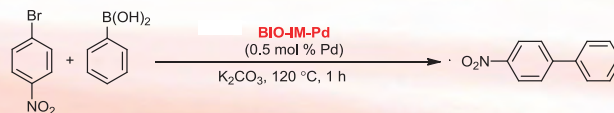
Surface structure of BIO-IM-Pd



Pd nano-particles are attached on BIOX surface.

Applied to Suzuki-Miyaura coupling reaction

solvent-free, solid-state reaction !!



Run	1st	2nd	3rd	4th	5th
conv. (%) <sup>a</sup>	97	98	98	94	94

<sup>a</sup> Determined by <sup>1</sup>H NMR spectra.

Mandai, K. et al., Tetrahedron Lett. 53, 329-332 (2012).

BIO-IM-Pd displayed excellent recyclability !!