

Supplementary Materials

New perspective to iron-based nanostructures

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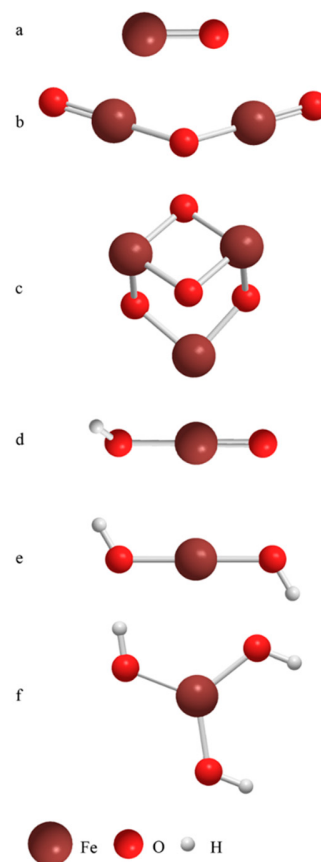
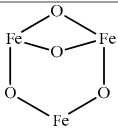


Figure S1. Molecular structures of iron compounds, FeO (a), Fe₂O₃ (b), Fe₃O₄ (c), FeOOH (d), Fe(OH)₂ (e), and Fe(OH)₃ (f)

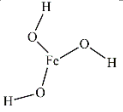
Table S1. A tabular summary of the data that provided in the main manuscript.

Iron Structure	Chemical formula	Chemical structure	Crystal system	Magnetic properties	Color	Synthesis process	Applications
Zero-valent iron	Fe ⁰	Element	Cubic	Ferromagnetic	Silver to black or gray, with metallic sheen	Top down or reduction of iron ions	Environmental sciences, and antimicrobial agents
Iron Oxides							
Ferrous oxide (wustite)	FeO	Fe=O	Cubic	Anti-ferromagnetic	Gray-black with greenish shade	Co-precipitation, polyol method, pyrolysis (thermal decomposition), micro emulsion, hydrothermal, sol-gel synthesis, and ball milling	Antimicrobial agents, and radiation filters
Ferric oxide							
		Anhydrous ferric oxides					

Hematite	α -Fe ₂ O ₃	O=Fe–O–Fe=O	Rhombohedral and hexagonal	Ferromagnetism or superparamagnetic	Red metallic	Precipitation, polyol process, pyrolysis of organometals, micro emulsion, hydrothermal synthesis, sol-gel process, calcination, and biosyntheses	Steel industries, jewelries, pigment, electrochemical devices, nanofluidic, environmental sciences, fertilizers, and phytomedicine
	β -Fe ₂ O ₃	O=Fe–O–Fe=O	Cubic	Antiferromagnetic	Reddish brown	Solid state reaction, hydrolysis	Water splitting and hydrogen production
Maghemite	γ -Fe ₂ O ₃	O=Fe–O–Fe=O	Cubic and tetragonal	Ferrimagnetic and superparamagnetic in nanoscales	Brown or reddish brown	Co-precipitation, polyol process, micro emulsion, hydrothermal synthesis, sol-gel process, pyrolysis, and	Electrocatalysts, magnetic recording, magnetic fluids, electrochromic devices, environmental sciences, fertilizers,

							oxidation of magnetite nanoparticles via thermic treatments	medical and pharmaceutical sciences, cell labeling, and magnetic bio-sensors
		$\epsilon\text{-Fe}_2\text{O}_3$	$\text{O}=\text{Fe}-\text{O}-\text{Fe}=\text{O}$	Orthorhombic	Ferromagnetic	-	-	magnetic force microscopes
		$\zeta\text{-Fe}_2\text{O}_3$	$\text{O}=\text{Fe}-\text{O}-\text{Fe}=\text{O}$	-	Antiferromagnetic	-	-	-
	Hydrous ferric oxide (Ferrihydrite)	$5\text{Fe}_2\text{O}_3 \cdot 9\text{H}_2\text{O}$	$\text{O}=\text{Fe}-\text{O}-\text{Fe}=\text{O}$	Hexagonal	Paramagnetic	Dark brown or reddish-brown	Precipitation, biosynthesis	Contrasting agent for MRI, environmental sciences
Ferrous ferric oxide	Magnetite	Fe_3O_4		Cubic-hexaoctahedral	Ferrimagnetic, Superparamagnetic in nanoscales	Black with a metallic opaque sheen	Pyrolysis, polyol process, micro emulsion, hydrothermal synthesis, sol-gel, and coprecipitation	Data storage and transfer, Environmental sciences, medical and pharmaceutical sciences, magnetic

Ferric oxide- hydroxide (ferric oxyhydrox ide)	labeling and magnetic separation							
	Anhydrou s ferric oxyhydrox ides							
	Goethite (α -FeOOH)	FeO(OH)	O=Fe–OH	Orthorh ombic	Antiferromag netic	Dark brown or black and yellow	Precipitatio n	Jewelries, pigments, and environme ntal sciences
	Akaganeite (β -FeOOH)	FeO _{0.833} (O H) _{1.167} Cl _{0.16} 7	O=Fe–OH	Monocli nic	Antiferromag netic	Tan brown with a metallic sheen	Hydrolysis	Adsorbents , catalysts, magnetite nanorods fabrication
	Lepidocroci te (γ - FeOOH)	FeO(OH)	O=Fe–OH	Orthorh ombic	Anti- ferromagnetic	Ruby red to orange- brown, with a semi- metallic sheen	Oxidation of zero- valent iron nanostruct ures, precipitatio n	Jewelries, Environme ntal sciences, adsorbents, catalysts

		Feroxyhyte (δ -FeOOH)	FeO(OH)	O=Fe–OH	Hexagonal	Superparamagnetic or ferromagnetic	Yellowish-brown	Rapid oxidation, γ -irradiation	Environmental sciences, coating of nano-adsorbents, photocatalysts, and hydrogen generation
		Schwertmannite	Fe ₈ O ₈ (OH) ₈ - 2x(SO ₄) _x ·n H ₂ O (1 ≤ x ≤ 1.75)	O=Fe–OH	Tetragonal	paramagnetic	Opaque yellowish brown	Precipitation, biosynthesis	Absorbent material for water treatment and soil remediation purposes
	Hydrated ferric oxyhydroxides	Bernalite	Fe(OH) ₃		Flattened pyramidal to pseudo-octahedral	-	Transparent to opaque with pale green (bottle-green)	Precipitation	Environmental sciences, and catalysts
Iron hydroxides	Ferrous hydroxide		Fe(OH) ₂ or FeH ₂ O ₂				Greenish to reddish brown	Precipitation	Fenton-like catalyst