INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Název: # Úvod a vysvětlení základních způsobů modifikace magnetických částic

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Reg.č.projektu: CZ.1.07/2.4.00/31.0023

Název projektu: Partnerská síť centra excelentního bionanotechnologického výzkumu

Applications of iron oxide based nanoparticles

Industry: catalysts, pigments, abrasives, gas sensors, magnetic storage media, ferrofluid technologies, magnetocaloric refrigeration, solar energy transformation

Mineralogy: magnetic separations   Biology: magnetotactic bacteria

Archeology: magnetic prospecting of archeological areas

Medicine: contrast agents in magnetic resonance imaging, blood detoxication – dialysis, treatment of certain tumors, drug delivery

Syntheses

Nanocomposites, films

Sol-gel process, aerosol pyrolysis, microwave plasma synthesis, mechanical activation of Fe-bearing precursors, hydrothermal deposition, diode sputter deposition, chemical vapor deposition methods

Nanopowders

Ball-milling, thermally, laser or microwave induced pyrolyses of Fe-bearing solutions,

combustion flame process, sonochemical syntheses, hydrolysis-based syntheses

Syntheses based on the thermally induced solid-state reactions

Advantages

- simple and cost-effective methods
- the preparation of a large amount of pure nanopowder without any support material or matrix (technological aspect)
- properties of Fe-bearing precursors predetermine the properties of iron(III) oxide nanoparticles (particle structure and morphology)

"genetic models": γ-FeO(OH) $\rightarrow$ γ-Fe_2O_3 α-FeO(OH) $\rightarrow$ α-Fe_2O_3

- possibility to control the structure, size and morphology of nanoparticles using the precursor properties (structure, particle morphology, crystallinity) and reaction conditions (temperature, atmosphere, diffusion conditions, external magnetic field)

Problems

- postprocessing (magnetic, sedimentation, dissolution) separation of nanoparticles from solid precursors or by-products

nanophase	precursor	temperature	size	reference
α-Fe_2O_3	$Mg_{3-x}Fe_xAl_2Si_3O_{12}$	1100 °C	15-20 nm	R. Zboril, M. Mashlan, K. Barcova, J. Walla, E. Ferrow, P. Martinec: *Phys. Chem. Miner*. **30** (2003) 620-627.
β-Fe_2O_3	NaCl, $Fe_2(SO)_3$	400 °C	15-22 nm	R. Zboril, M. Mashlan, D. Petridis: *Chem. Mater*. **14** (2002) 969.
β-Fe_2O_3	$Fe_2(SO)_3$	600 °C	40-50 nm	R. Zboril, M. Mashlan, D. Krausova, P. Pikal: *Hyperfine Interact.* **121-122** (1999) 497.
γ-Fe_2O_3	$Fe_2(C_2O_4)_3$	250 °C	4-7 nm	R. Zboril, M. Mashlan, K. Barcova, M. Vujtek: *Hyperfine Interact.* **139**, (2002) 597.
γ-Fe_2O_3	$Fe_{3-x}Mg_xAl_2Si_3O_{12}$	900 °C	7-12 nm	A. Bourlinos, R. Zboril, D. Petridis:, *Micropor. Mesopor. Mater.* **58** (2003) 155.
ε-Fe_2O_3	$Fe_2(SO_4)_3$	530 °C	40-60 nm	R. Zboril, M. Mashlan, V. Papaefthymiou, G. Hadjipanayis: *J. Nucl. Radioanal. Chem.* **255** (2003) 413.
am.-Fe_2O_3	$Fe_4[Fe(CN)_6]_3$	230 °C	1-3 nm	R. Zboril, L. Machala, M. Mashlan, V. Sharma: *Crystal Growth & Design* **4,** (2004) 1317.
am.-Fe_2O_3	FeC_2O_4	180 °C	1-2 nm	M. Mashlan, R. Zboril, et al. *J. Metastab. Nanocryst. Mater*. **20-21** (2004) 641.
Fe_3O_4/MgO	am. Fe_2O_3, Mg	300 °C	30-40 nm	O. Schneeweiss, R. Zboril, N. Pizurova, M. Mashlan, E. Petrovsky, J. Tucek: *Nanotechnology* **17**, 607-616 (2006).
α-Fe/MgO	am. Fe_2O_3, Mg	600 °C	50 nm	

Experimental system

Particle size and morphology, surface characterization, size distribution

- **AFM, BET surface area measurements, DLS particle size analysis**
- **TEM**

Structural and magnetic characterization

- **XRD, EPR, IR spectroscopy (UP Olomouc)**
- **SQUID magnetization measurements (NCSR Demokritos, Athens)**
- **low/high temperature, external field Mössbauer spectroscopy (1.5 -1200 K, 10T, UP Olomouc)**
- **VSM magnetic measurements (IPHT Jena)**
- **HRTEM (Hahn-Meitner Institute Berlin)**

Thermal behaviour

- **TG/DTA/DSC (25-1000 °C, UP Olomouc)**
- **Thermomagnetic curves (25-1000 °C, IPM ASCR Brno)**

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Děkuji Vám za pozornost

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