

Funkcionalizace nanočástic -stabilizace

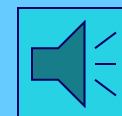


Brno, PS 2012

Audio test:



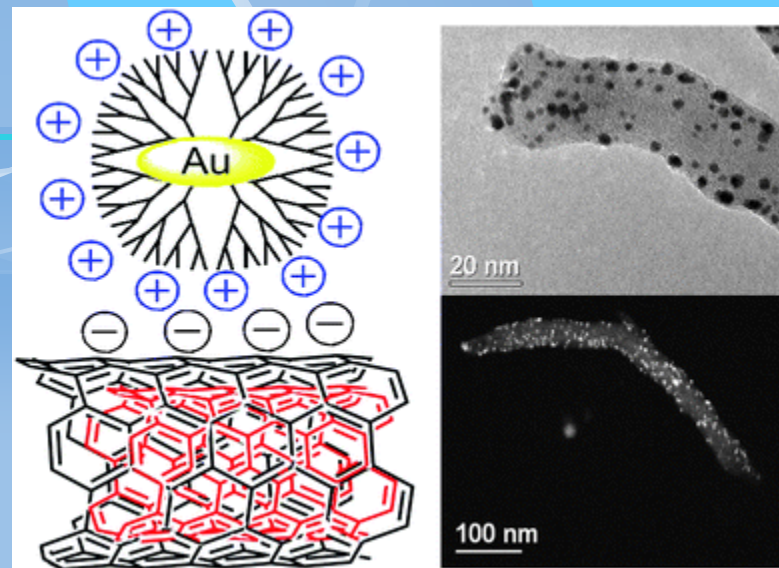
Start



Přednášející: doc. Jiří Sopoušek E-mail:
sopousek@mail.muni.cz, tel.: 549497138

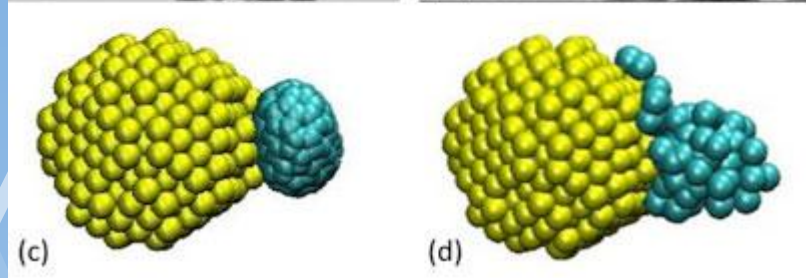
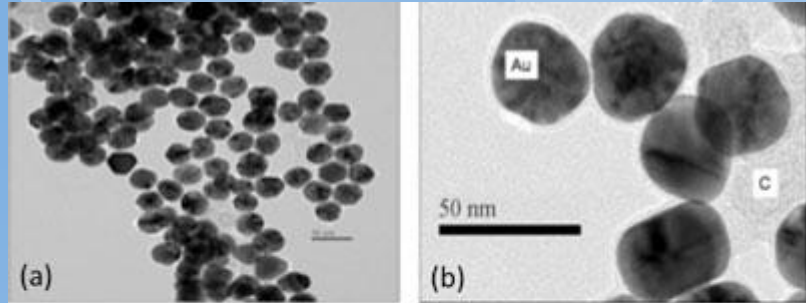
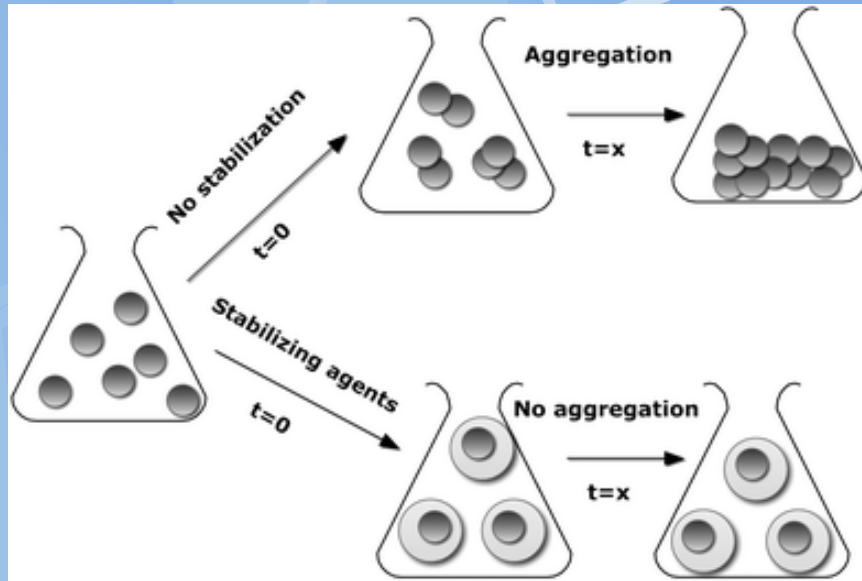
Office: UKB A12/M231

Ústav chemie: <http://ustavchemie.sci.muni.cz/>

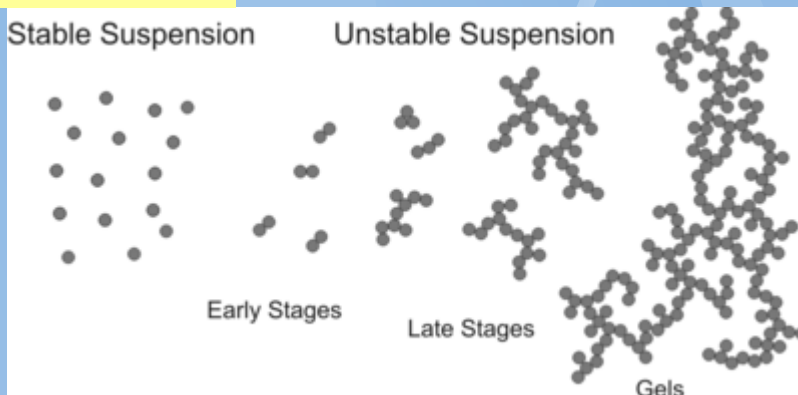


Au-nano

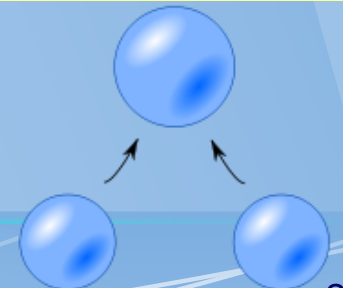
Proč stabilizovat NPs?



Agregace:

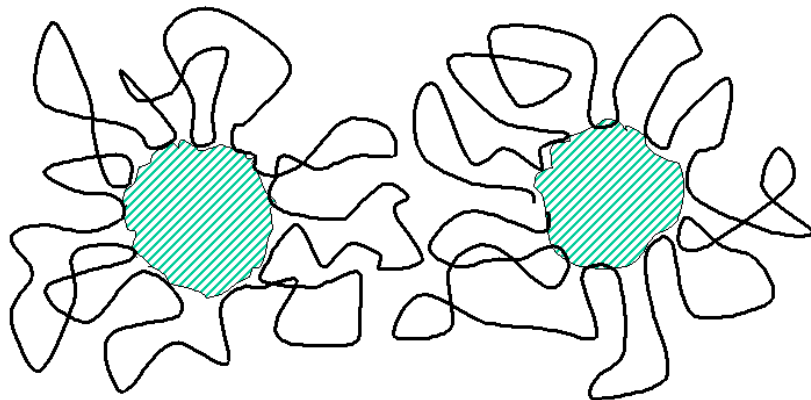


Koalescence:



Principy stabilizace NPs

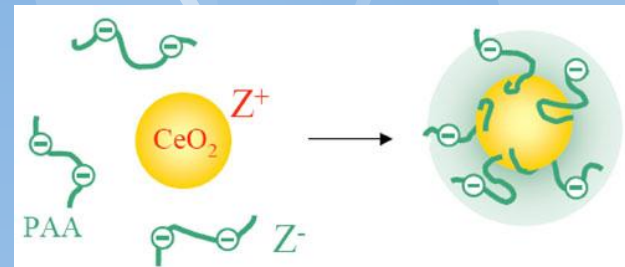
Steric Stabilization



M. Hubbe

- Rozpustné polymery (PEG, PAA (poly acrylic acid), PVA (poly vinyl alcohol), Chitosan, PNIPAM (Poly-N-isopropyl acrylamide),...)
- Surfactanty
- **100x nic(VW vazba) =silná vazba**

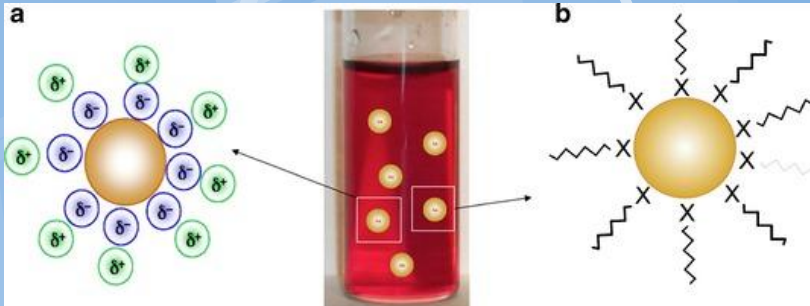
Adsorpce jednoduchých molekul na povrchu (slabá ochrana před agregací, funguje jen u částic s nulou povrchovou energií)



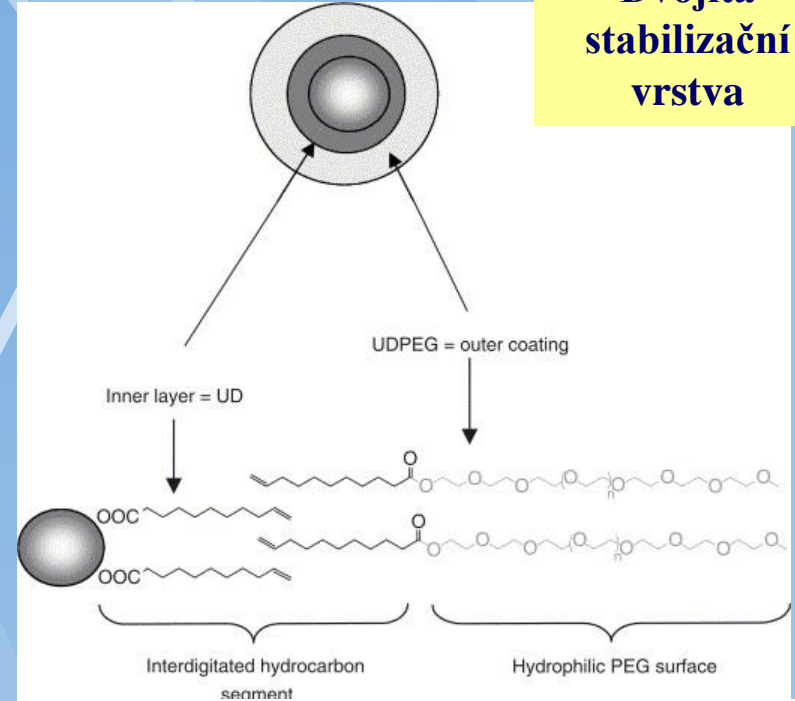
Electrostatic Stabilization (vysokomolekulární latky s nábojem, ..)

Stabilizace a vnější prostředí (v kapalinách)

Dvojitá
stabilizační
vrstva

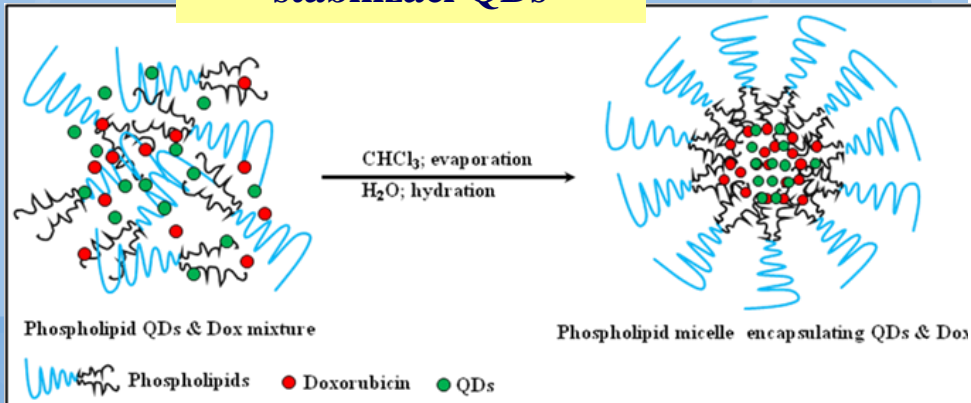


Stabilizace AuNPs v polárním a nepolárním prostředí



Sterická stabilizace SPIO ve vodě nebo hydrofilním prostředí

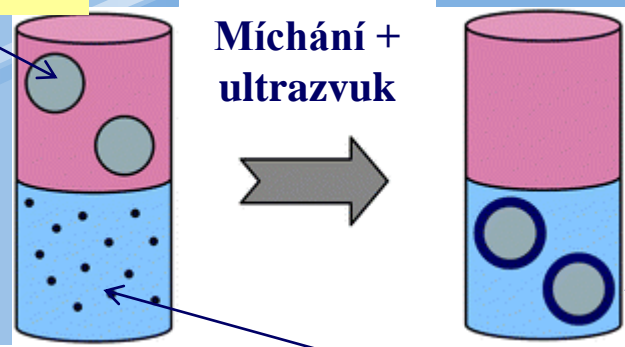
Vliv rozpouštědla na stabilizaci QDs



Sterická stabilizace QD v nepolárním prostředí lipidy

Přenos z hydrofobního rozpouštědla do vody

NPs s hydrofobní stabilizací

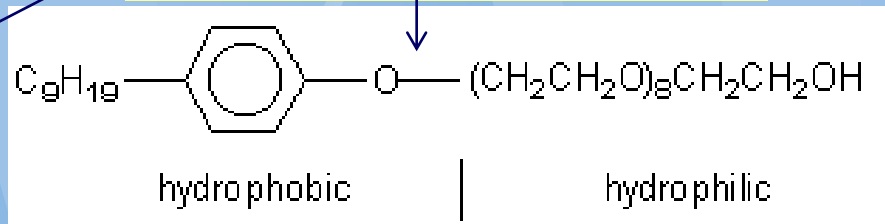
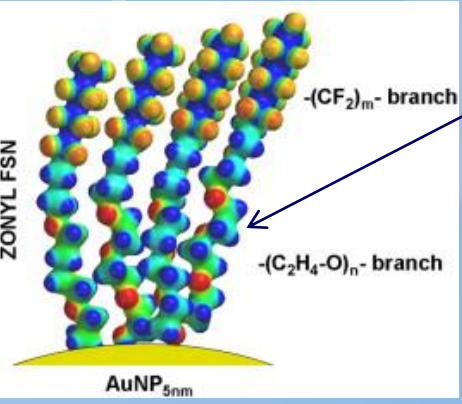


Stabilizace v nepolárním a hydrofobním prostředí za pomoci surfaktantu



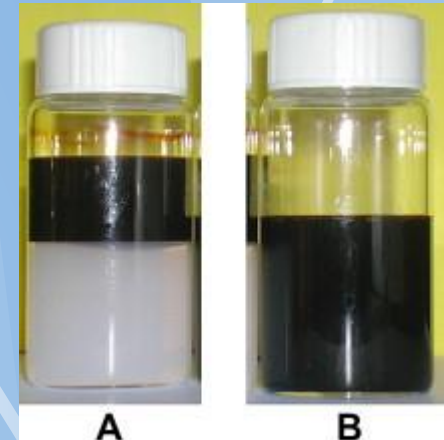
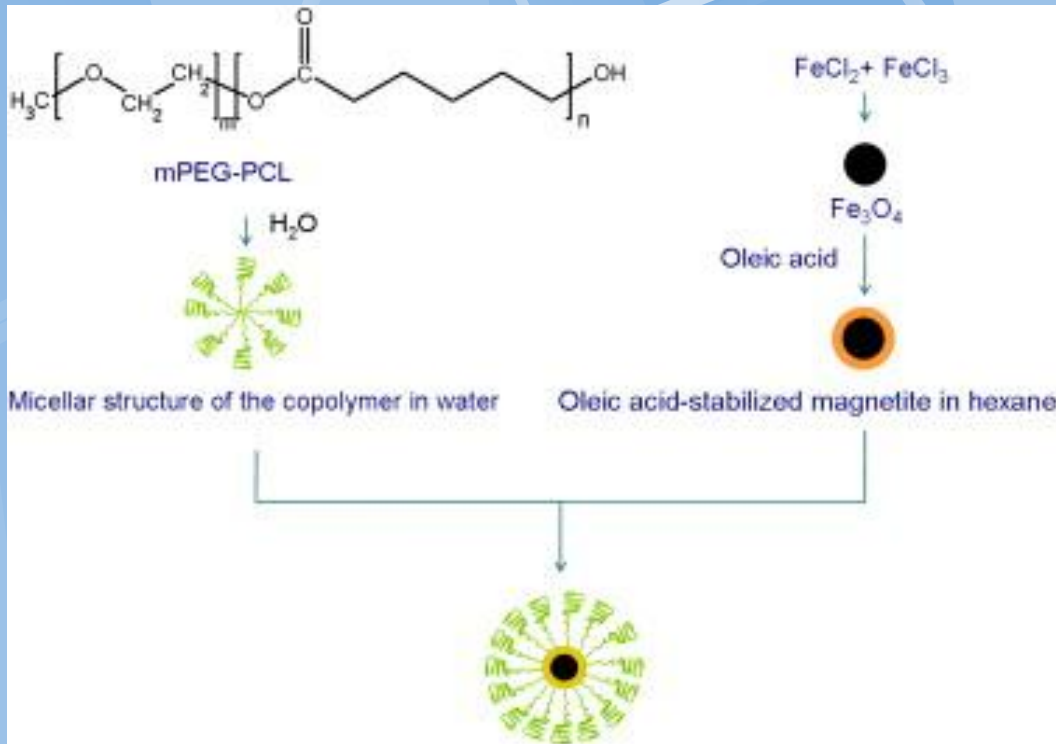
(IGEPAL)

Dual-interaction ligands (Oboustraně aktivní ligand):



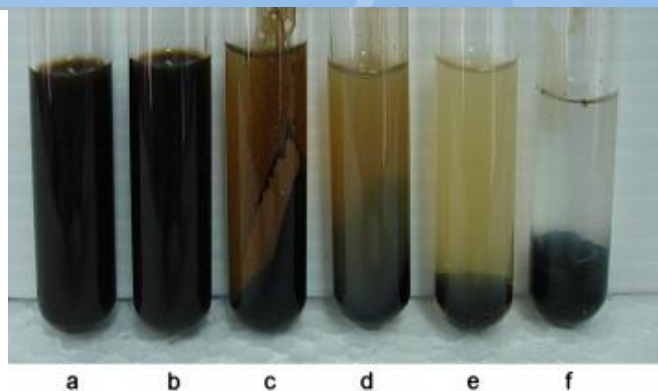
Igepal CO-630 nonionic surfactant

Příklad: Stabilizace a převod SPIO



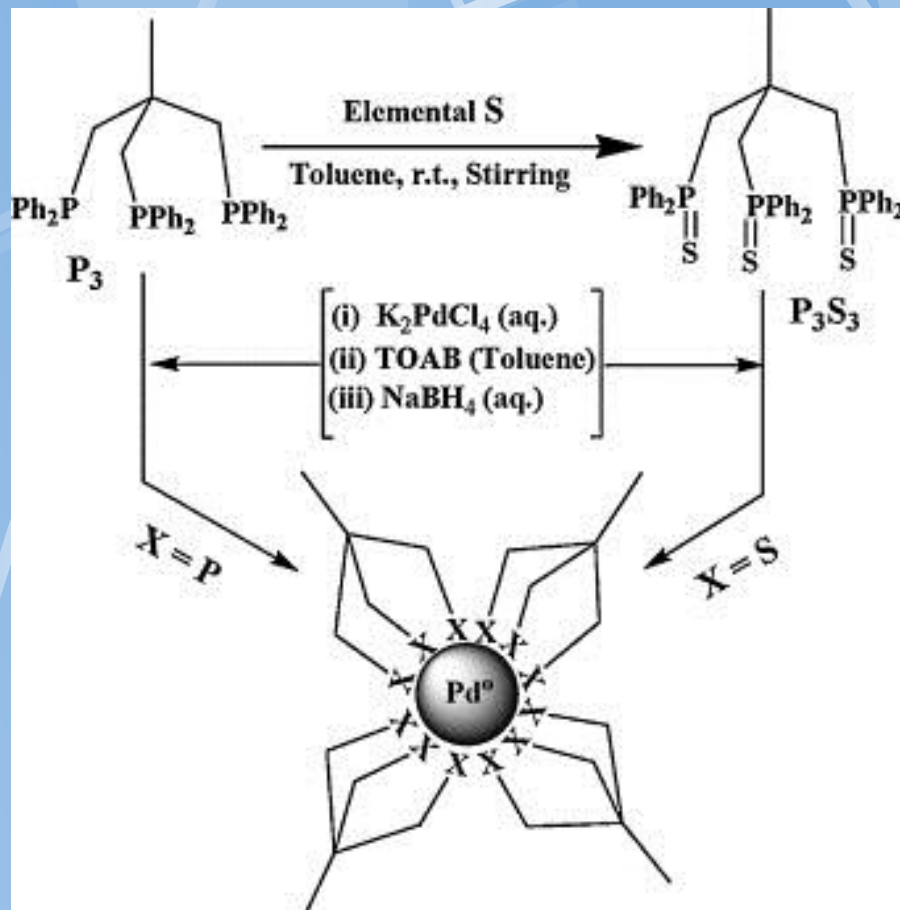
Dispersions of (A) oleic acid-coated Fe_3O_4 nanoparticles dispersed in hexane (top layer) and the copolymer solution in water (bottom layer) and (B) oleic acid/copolymer-coated Fe_3O_4 nanoparticles in water after sonication and decanting hexane top layer.

Fe_3O_4 nanoparticle dispersions in water at (a) 5, (b) 1, (c) 0.5, (d) 0.1, (e) 0.01 and (f) 0.001 wt% of the copolymer concentrations.



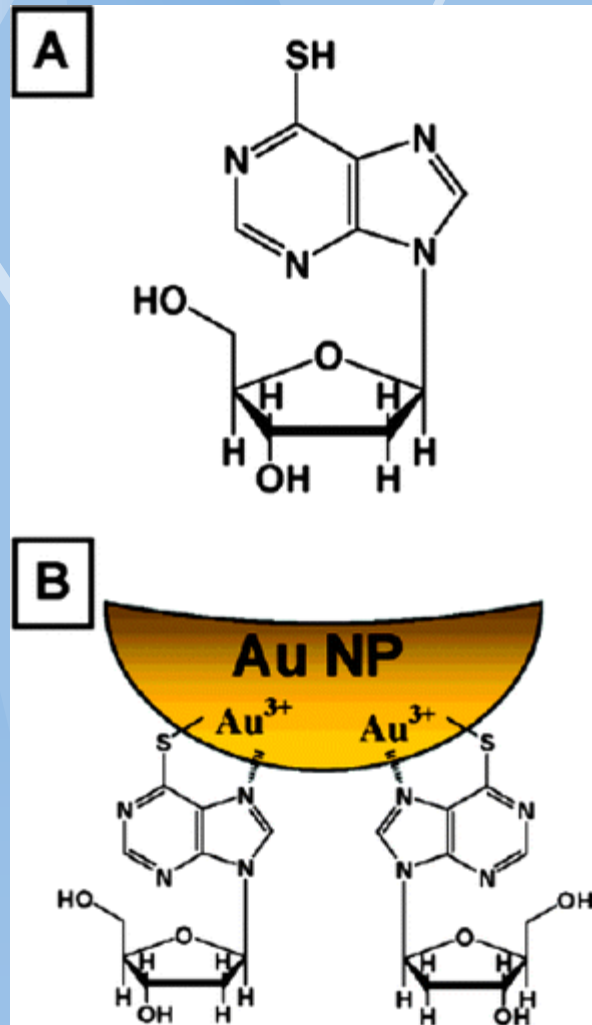
Určení optimální koncentrace (titrací?)

Stabilizace vazbami P, S, N na Me



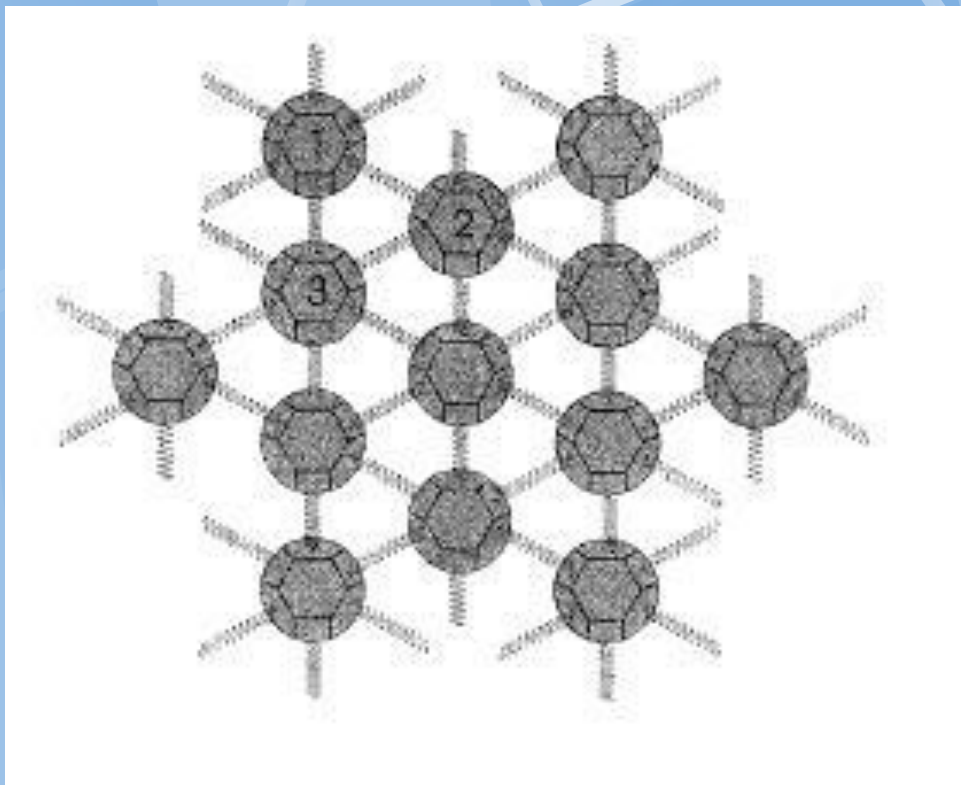
Pd^0 -nanoparticles stabilized by tripodal phosphine based ligands

<http://www.sciencedirect.com/science/article/pii/S092058611200329X>



<http://pubs.rsc.org/en/content/articlehtml/2009/cs/b806051g>

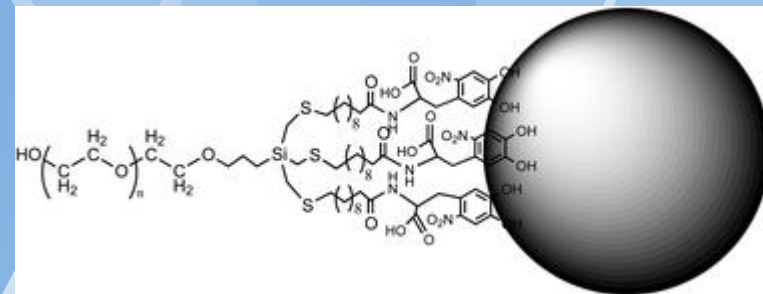
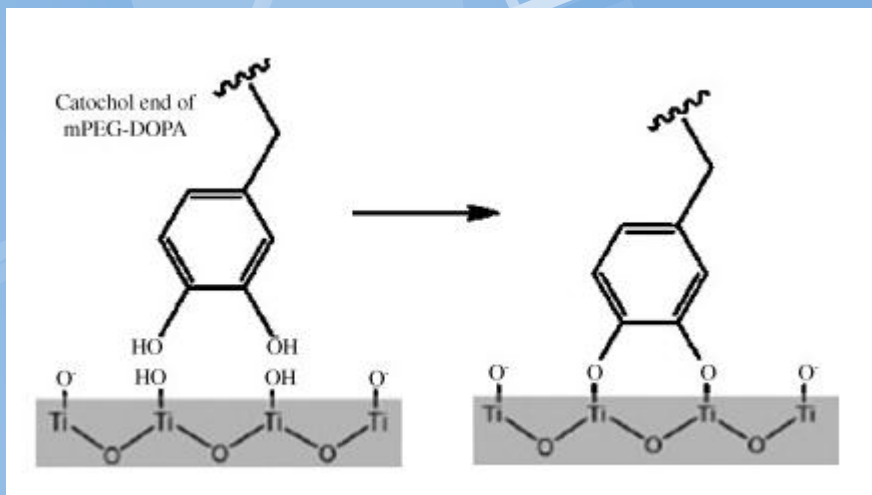
Strukturní stabilizace vznik síťových struktur



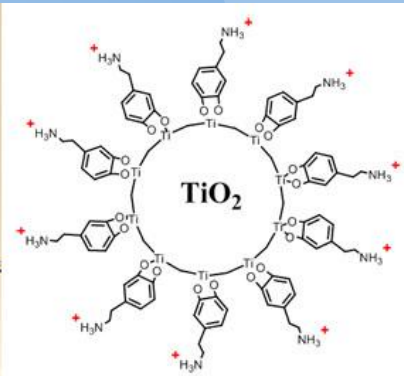
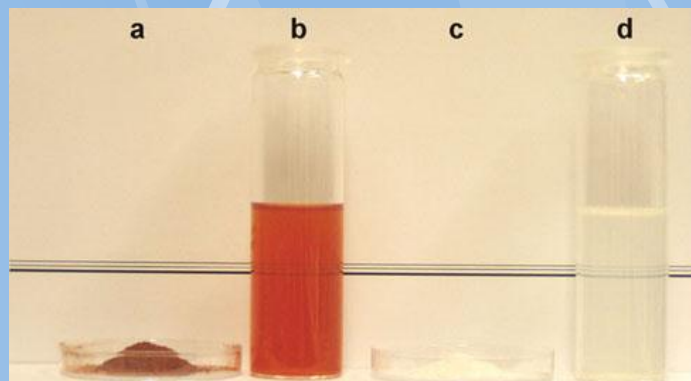
**Za přítomnosti
reakčních míst
umožňujících vazby
mezi NPs.**

**3D Arrangement of
thiol-linked truncated
octahedral silver
particles**

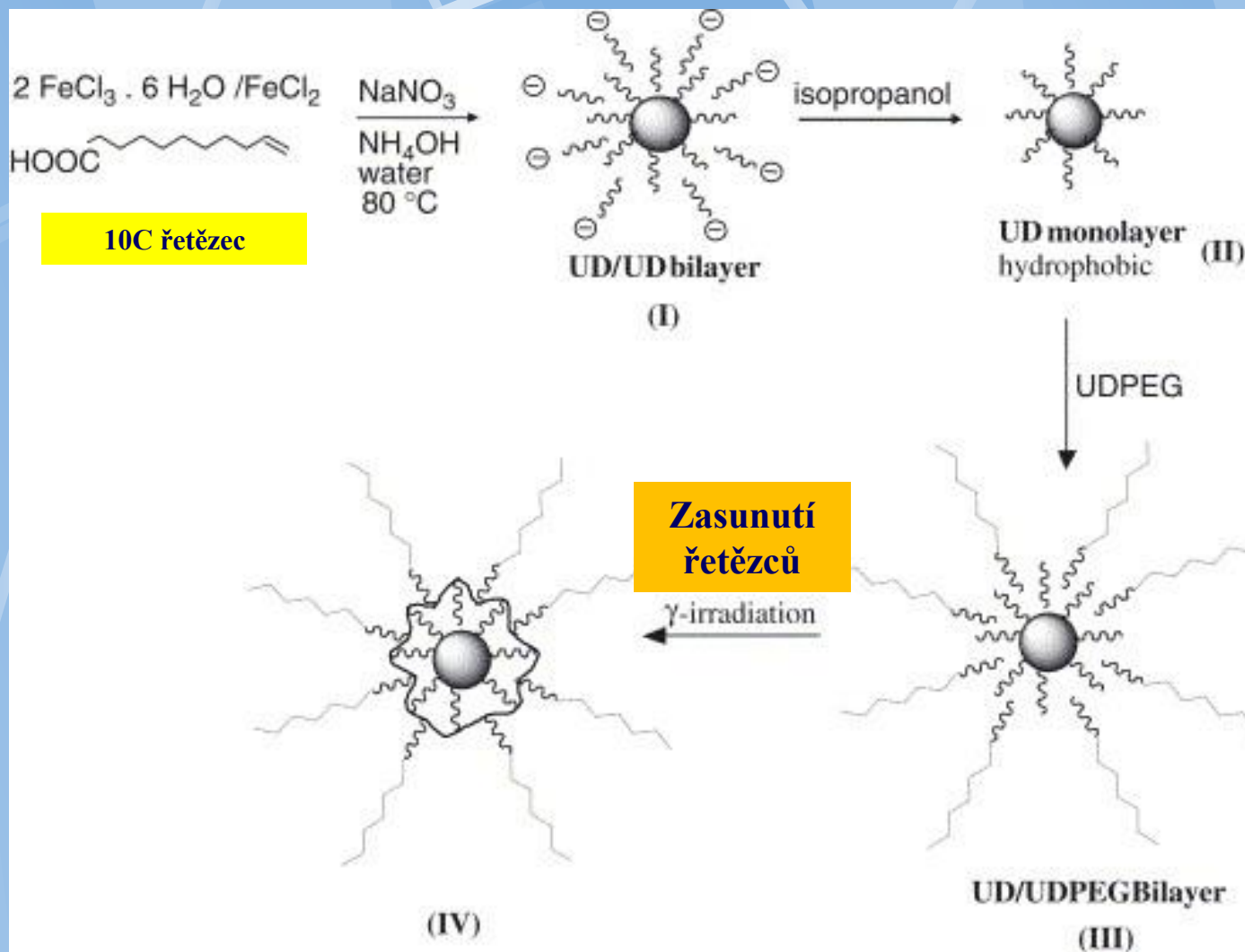
Stabilizace MeO NPs



Malá povrchová energie oxidů, nereaktivita na vzduchu, snadná adsorpce malých molekul. Snadný vznik vazeb přes přes O

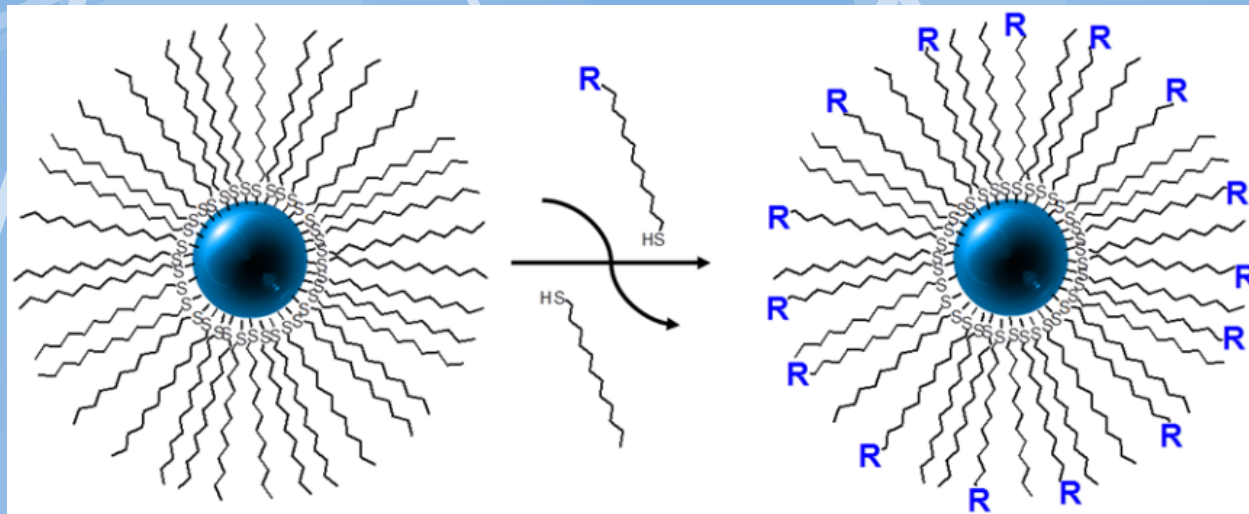


Příprava stabilizační obálky SPIO



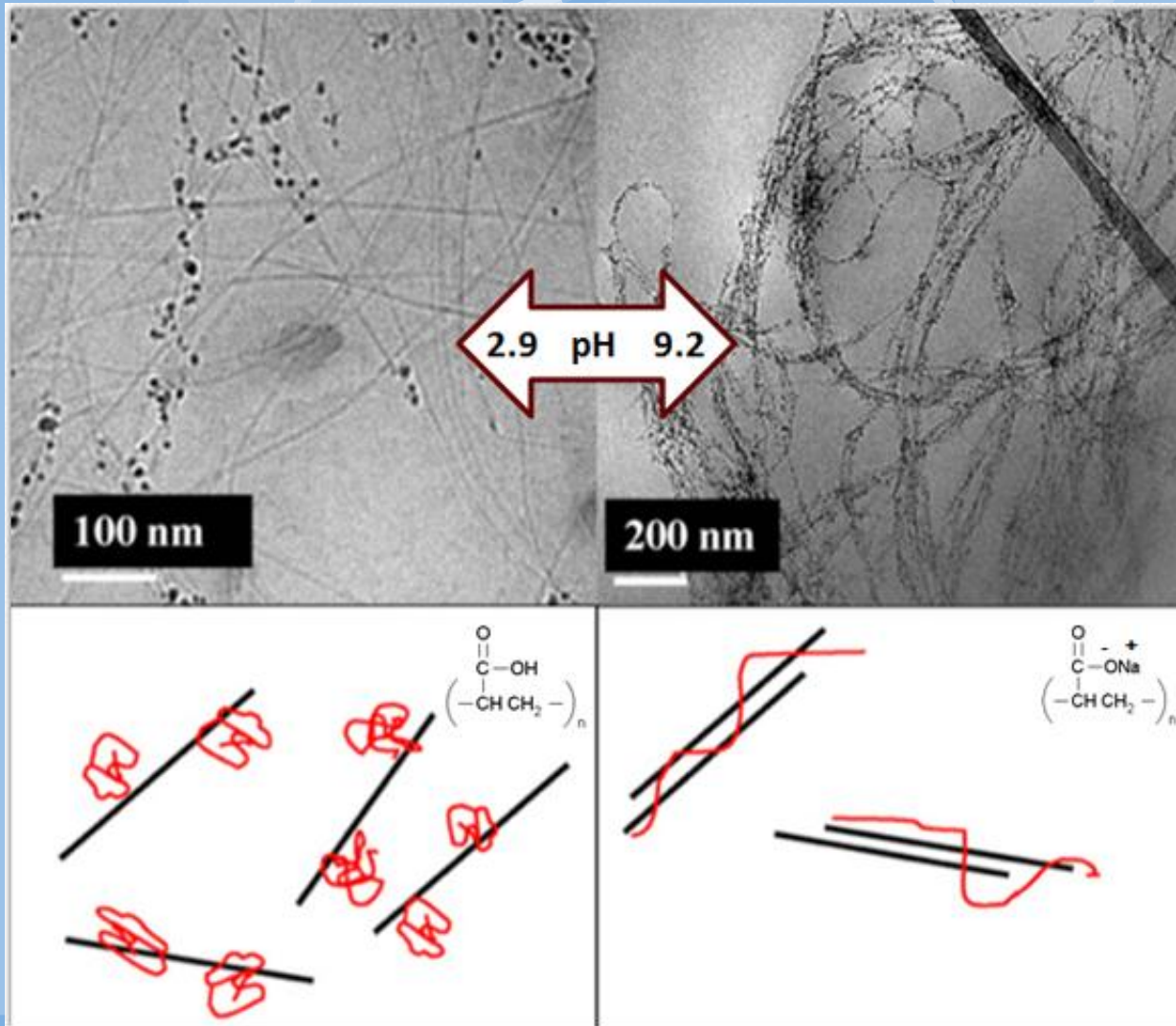
Name	Magnetic core		Core diameter/nm	Hydrodynamic diameter/nm	Magnetization			Ref.	
	material	Surface			M_{sat} /emu g ⁻¹	r_1	r_2		B_0 /T
<p>^a r_1: longitudinal relaxivity; r_2: transverse relaxivity; B_0: magnetic field strength. ^b DMSA: 2,3-dimercaptosuccinic acid; DSPE-mPEG; 1,2-distearoyl-<i>sn</i>-glycero-3-phosphoethanolamine-<i>N</i>-[methoxy(polyethylene glycol)-2000]. ^c Multiple iron oxide nanoparticles are assembled on the surface of silica nanoparticles.</p>									
Ferumoxide (Feridex)	Fe ₃ O ₄ , γ -Fe ₂ O ₃	Dextran	4.96	160	45	10.1	120	1.5	<u>10</u>
ESION	γ -Fe ₂ O ₃	PEG	3	15		4.77	29.2	3	<u>24</u>
MnMEIO	MnFe ₂ O ₄	DMSA ^b	12		110		358	1.5	<u>26</u>
CoMEIO	CoFe ₂ O ₄	DMSA ^b	12		99		172	1.5	<u>26</u>
NiMEIO	NiFe ₂ O ₄	DMSA ^b	12		85		152	1.5	<u>26</u>
Zn-doped ferrite	Zn _{0.4} Mn _{0.6} Fe ₂ O ₄	DMSA ^b			175		860	4.5	<u>27</u>
Cannonball	Fe/Fe ₃ O ₄ core/shell	DMSA ^b	Properties of iron based MRI contrast agents (diagnostické SPIO látky)						
Fe@MFe ₂ O ₄ MNP	Fe/MnFe ₂ O ₄ core/shell	DMSA ^b	16		149	11	356	0.47	<u>30</u>
Fe/Fe ₃ O ₄ NP	bcc Fe/Fe ₃ O ₄ core/shell	PEG	15		164		220	3	<u>31</u>
magnetic resonance imaging (MRI)									
DySiO ₂ -(Fe ₃ O ₄) _n	9 nm Fe ₃ O ₄	DMSA ^b	45 ^c				397	9.4	<u>43</u>
Fe ₃ O ₄ -MSN	8.5 nm Fe ₃ O ₄	PEG	87 ^c	93			76.2	1.5	<u>44</u>
SPIO-14	Fe ₃ O ₄	DSPE-mPEG 1000 ^b	13.8	28.6			385	0.47	<u>46</u>
SPIO-5	Fe ₃ O ₄	DSPE-mPEG 1000 ^b	4.8	14.8			130	0.47	<u>46</u>

Výměna obálky za látku s vyšší afinitou k core



<http://www.beilstein-journals.org/bjoc/single/articleFullText.htm?publicId=1860-5397-8-39>

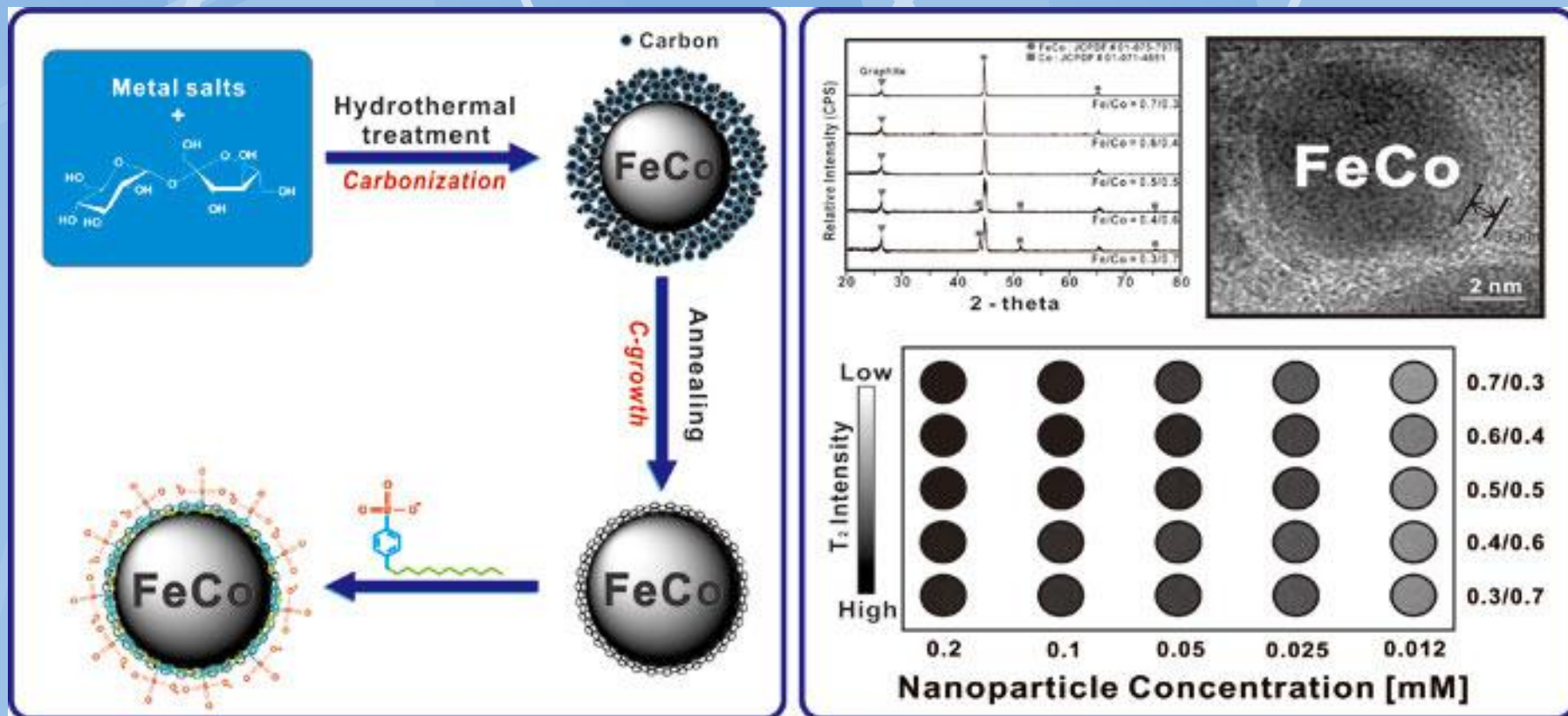
Vliv pH na stabilizaci (CNTs)



The figure shown above highlights one approach using poly(acrylic acid) to stabilize single-walled carbon nanotubes (SWNT) in water (*J. Coll. Interf. Sci.* 2008)

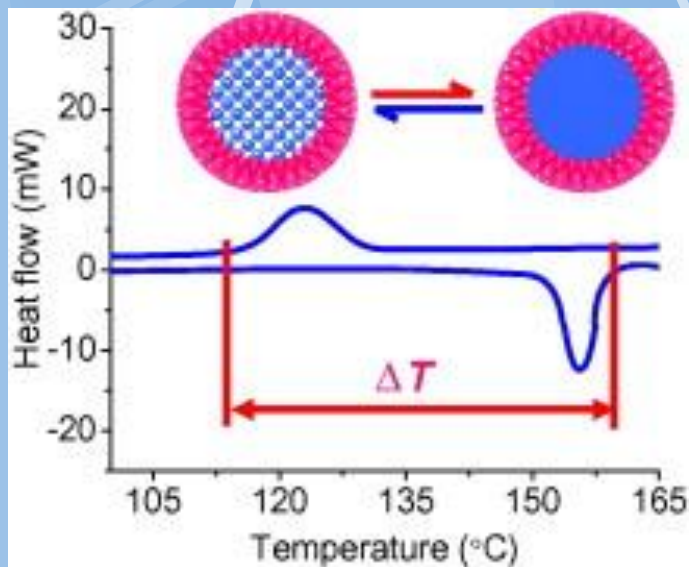
**Podpora
spojování
vlaken CNTs**

Encapsulate NPs



<http://nanotechweb.org/cws/article/lab/47172>

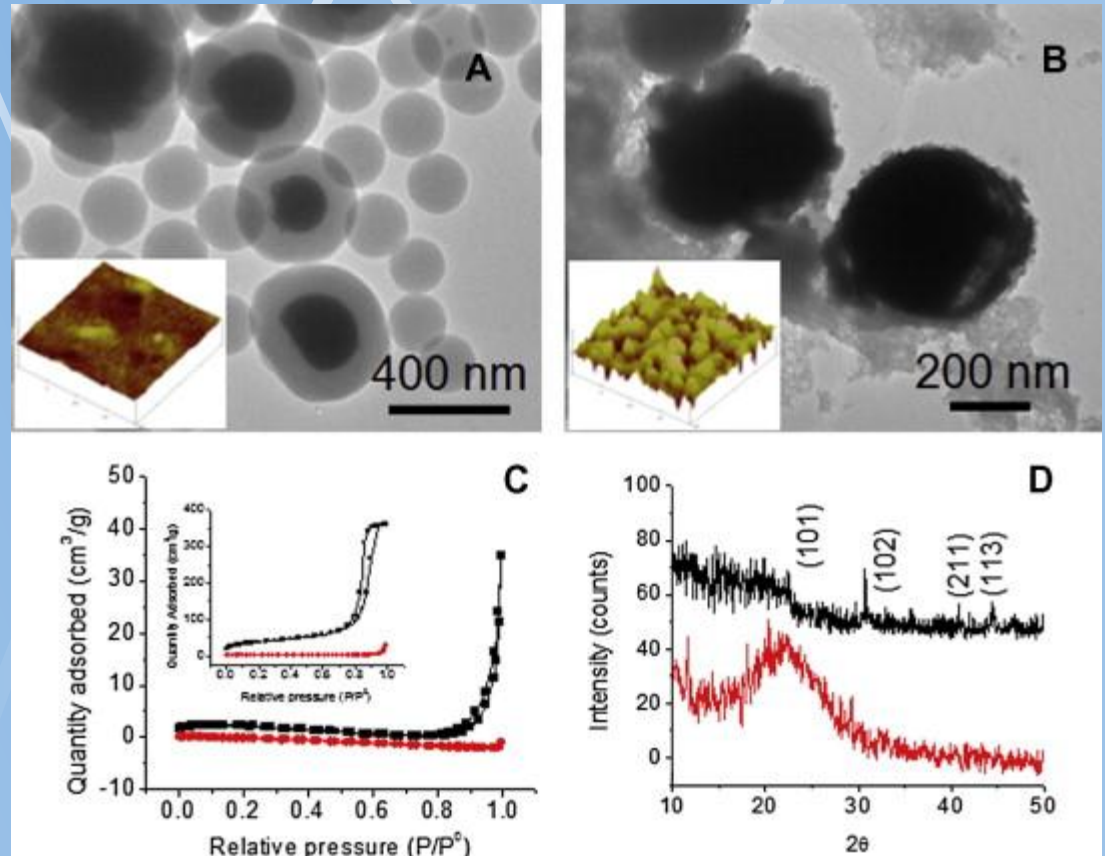
Tání a tuhnutí In encapsulated NPs



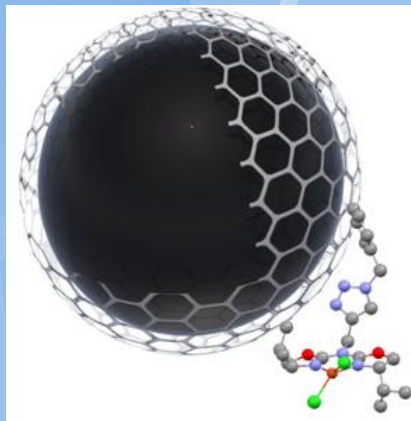
In encapsulated NPs

DSC:

<http://www.sciencedirect.com/science/article/pii/S0009261411001023>

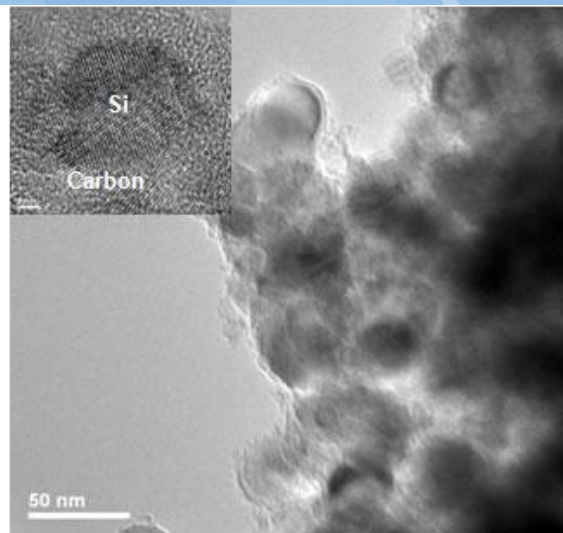
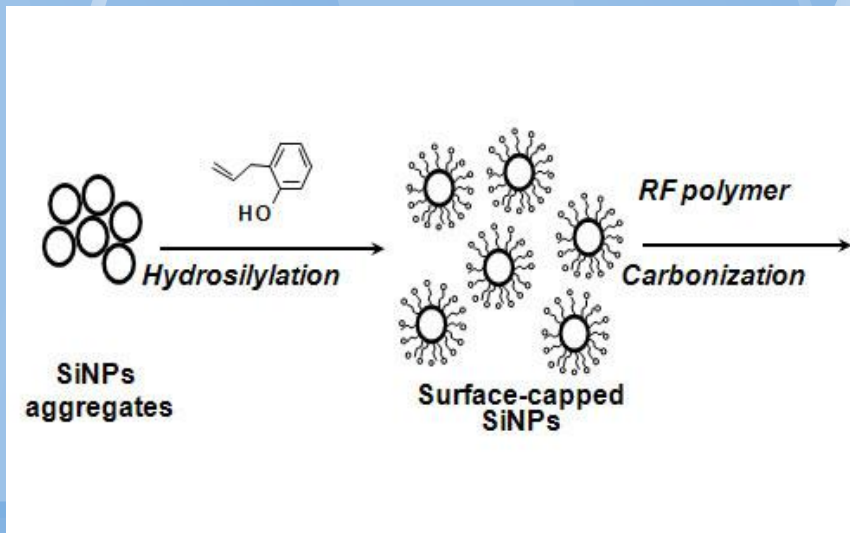
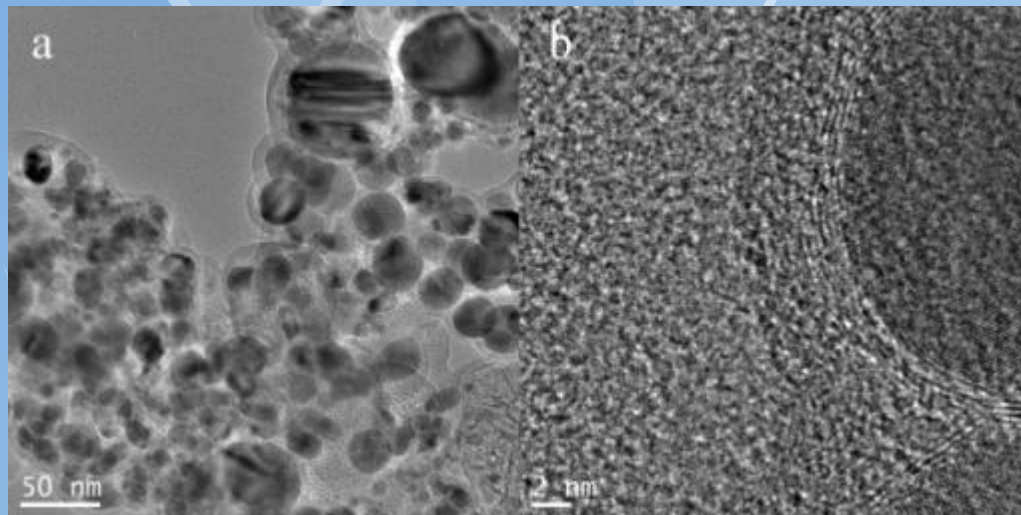


Karbonizace



Sketch of a functionalized carbon coated metal nanoparticle.

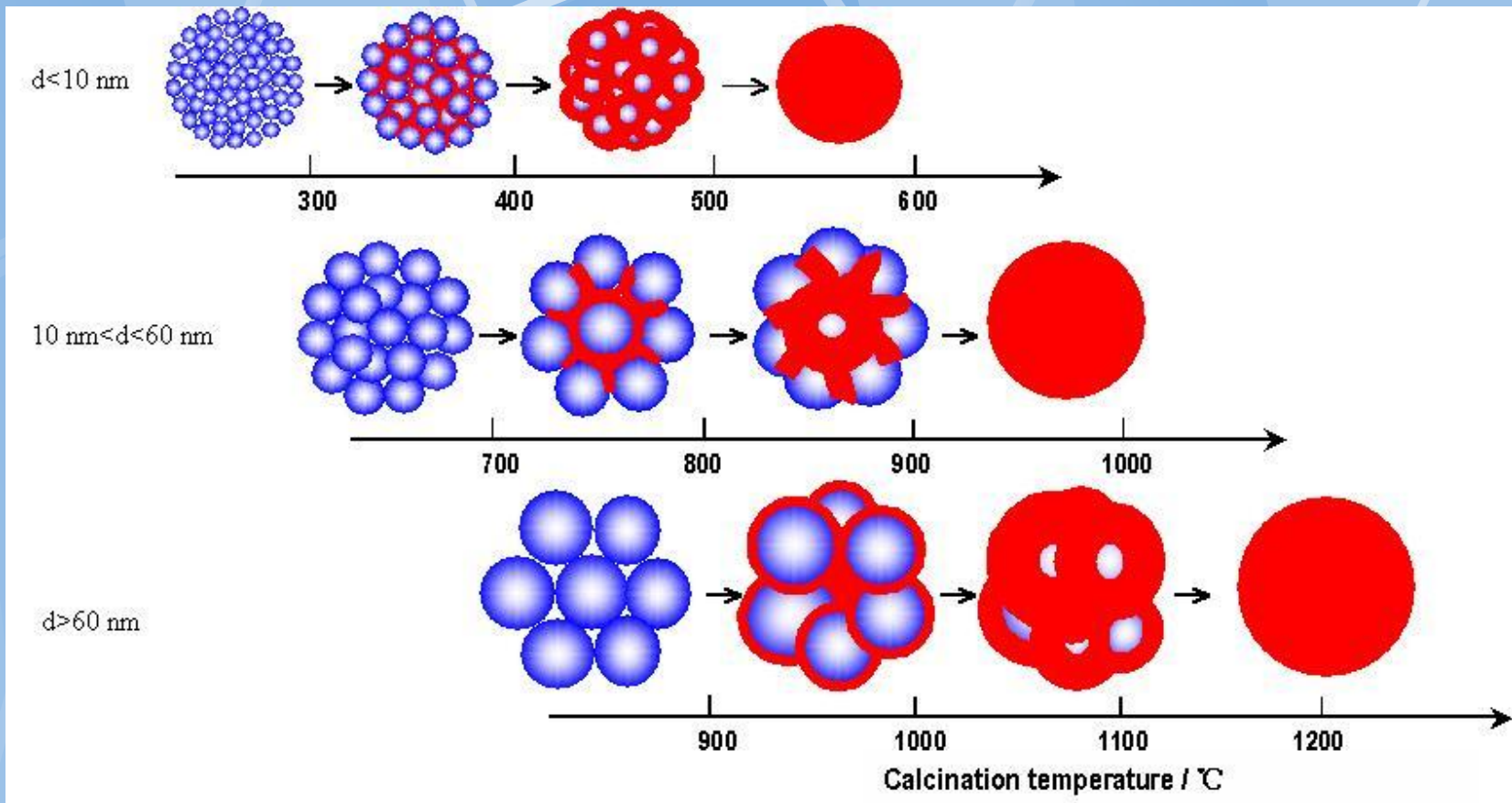
http://www.fml.ethz.ch/research/Magnetic_Chemistry



a) Nanoparticles encapsulated in several layers of graphitic carbon, and surrounded by amorphous carbon. b) Detail showing the atomic planes of the nanoparticle metallic core.

http://openi.nlm.nih.gov/detailedresult.php?img=2994779_1477-3155-8-26-1&query=the&fields=all&favor=none&it=none&sub=none&uniq=0&sp=none&req=4&simCollection=2589746_yjbm00053-0074-a&npos=55&prt=3

Vliv velikosti NPs na průběh karbonizace TiO₂ v oxidační atmosféře



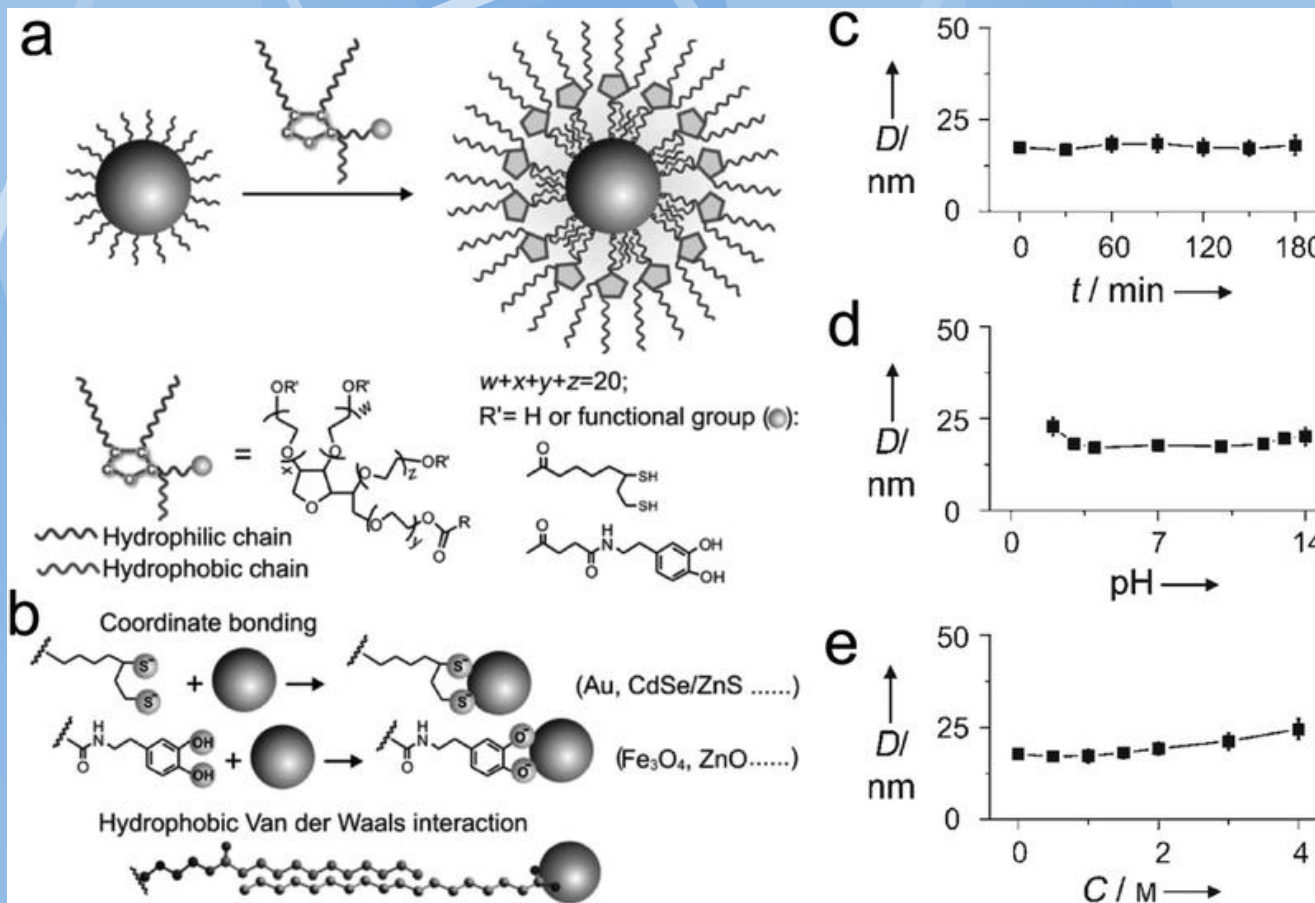
Article.

<http://dx.doi.org/10.1021/jp80801>

3k

Nanočástice
PS 2012 17

Vliv vnějšího prostředí na stabilitu NPs



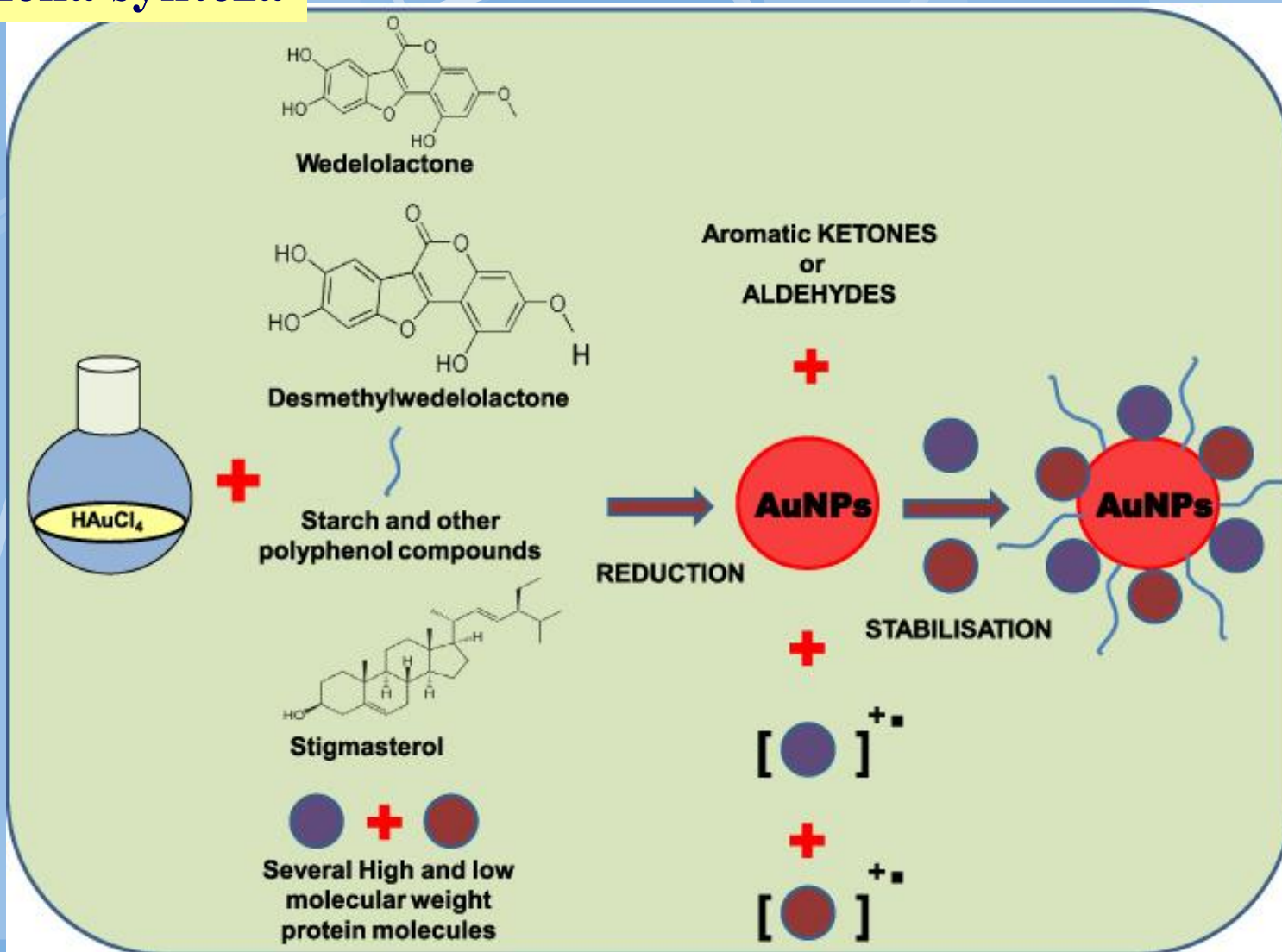
(a and b) Formation of water-dispersible nanoparticles using dual-interaction ligands (a) that bind onto the surface of nanoparticles by both co-ordinate bonding and hydrophobic van der Waals interaction (b). (c–e) Stability tests for iron oxide nanoparticles coated with dual-interaction ligands: (c) thermal stability test at 100 °C; (d) pH stability test; (e) stability as a function of salt (NaCl) concentration. Reprinted with permission from [ref. 62](#). Copyright 2008 Wiley-VCH.

Dobrý článek o stabilizaci:

<http://pubs.rsc.org/en/content/articlehtml/2012/cs/c1cs15248c>

Green synthesis and stabilization of biocompatible gold nanoparticles

Zelená syntéza



Patentování stabilizace

**Patent application title: GOLD,
SILVER, AND COPPER
NANOPARTICLES
STABILIZED IN
BIOCOMPATIBLE AQUEOUS
MEDIA**

Read more:

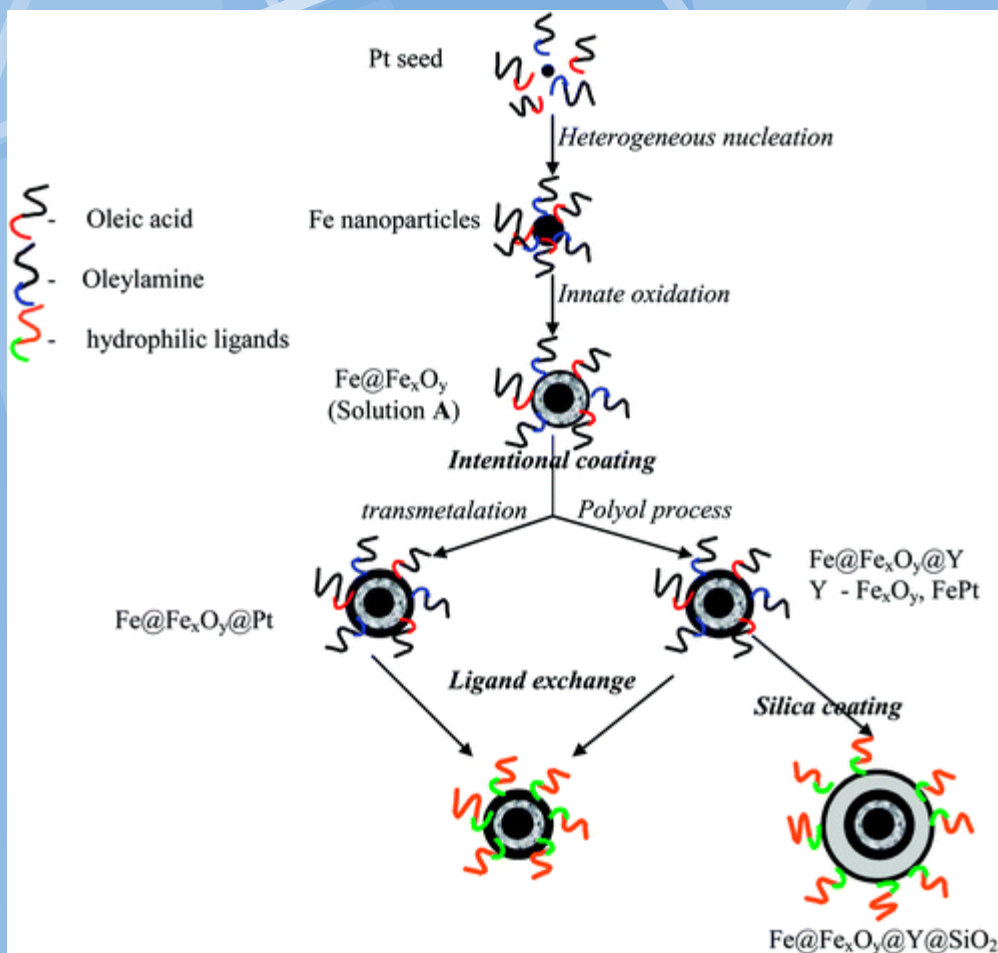
**[http://www.faqs.org/patents/app/
20100172997#ixzz2DilOrZoQ](http://www.faqs.org/patents/app/20100172997#ixzz2DilOrZoQ)**

6. The method of claim 1, wherein the one or more polymer stabilizers comprises agarose, hydrogels, PAA (poly acrylic acid), PVA (poly vinyl alcohol), Chitosan, PNIPAM (Poly-N-isopropyl acrylamide), substituted PNIPAM (including PNIPAM-aa (poly-N-isopropyl acrylamide-acrylic acid), PNIPAM-allylamine (Poly-N-isopropyl acrylamide-allylamine), and PNIPAM-SH), PAMAM (Polyamidoamine), PEG (Poly ethylene glycol), alginic acid, HPC (hydroxyl propyl cellulose), or a combination thereof.

Read more:

<http://www.faqs.org/patents/app/20100172997#ixzz2DilqNdgg>

Diskuse



<http://pubs.rsc.org/en/content/articlehtml/2008/NJ/B711870H>