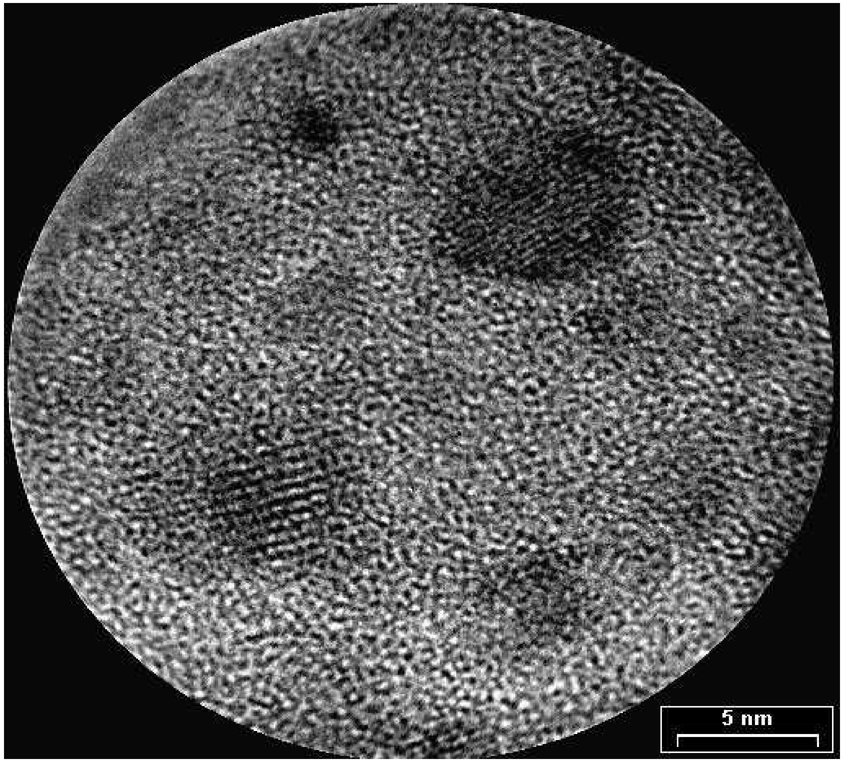
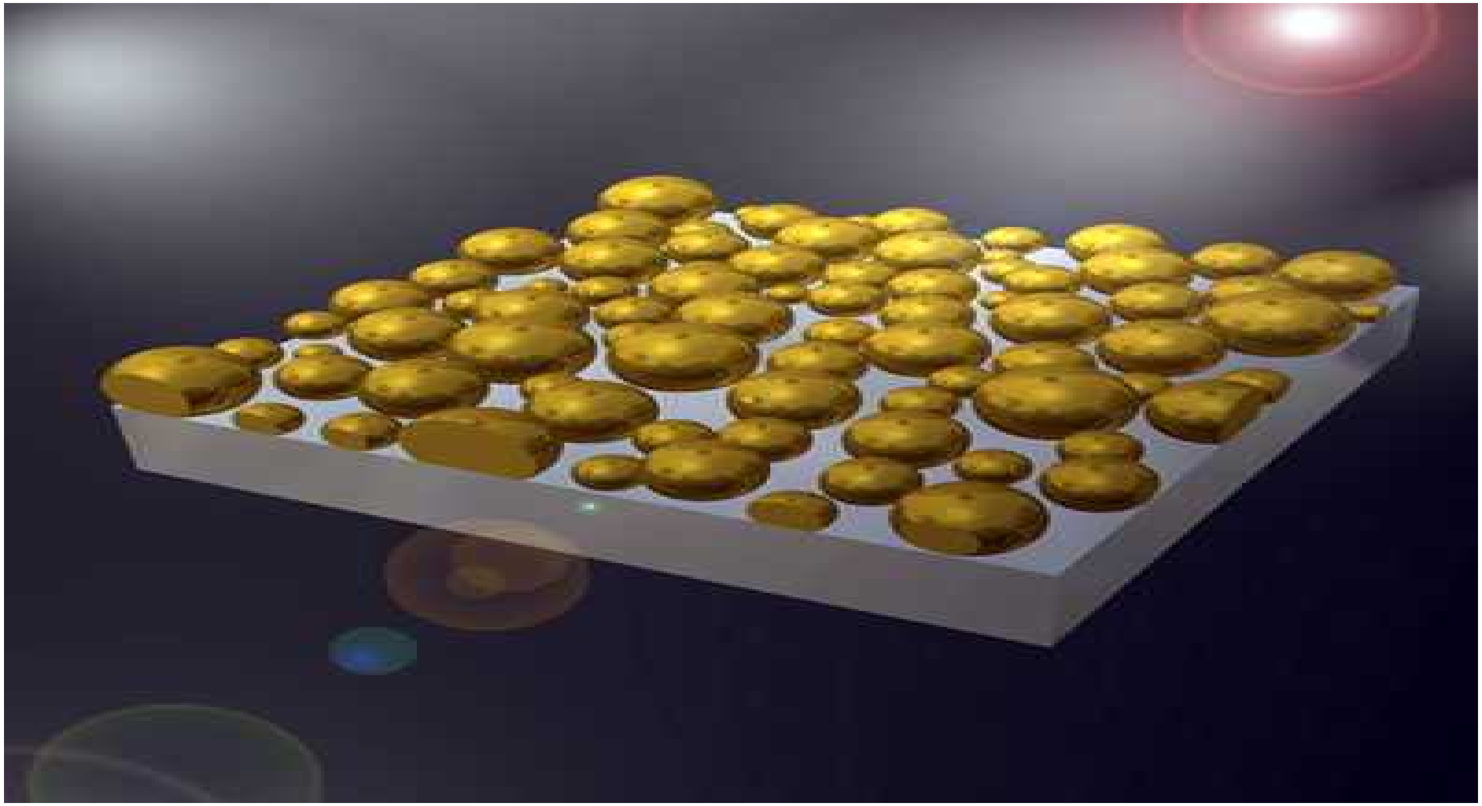
Applications of nanocomposites



Antireflection layers



Layers of metals, thickness several nm – individual islets scatter the ligh

Electronic skin

Equivalent sensitivity of human skin to pressure and temperature.

$BaTiO_3$ nanoparticles - dispersion in a matrix of ferroelectric polymer.

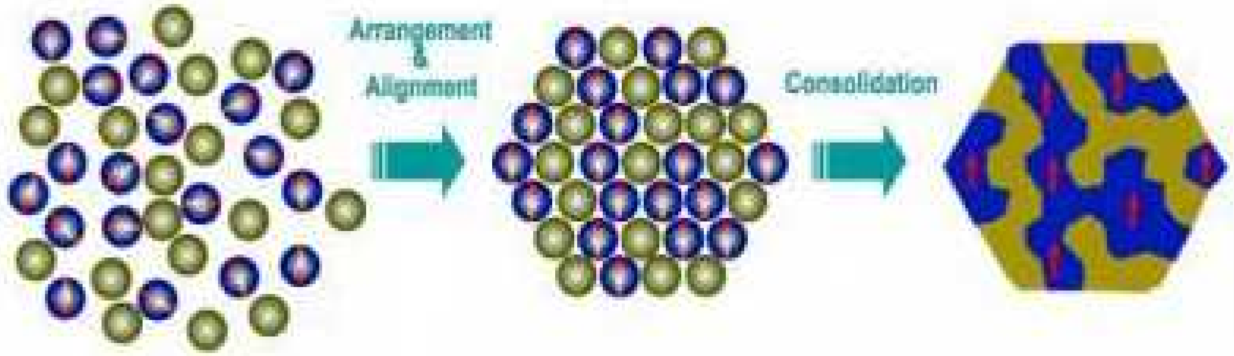
Orientation of dispersion and matrix is controlled independently.

If the polarization of dispersion and matrix are parallel, aborting piezoelectric properties of dispersion and matrix, and composite is sensitive to temperature (pyroefekt).

If the polarization of matrix and dispersion are antiparalel, appears to be in composite only piezoelectric effect - pressure response.

Super strong magnet

- Assembling a nanocomposite magnet from individual high-magnetization and high-coercivity nanoparticles critically depends on availability of anisotropic (single crystal) hard magnetic nanoparticles.



- Anisotropic RE-Co nanoparticles produced via surfactant-assisted HEBM satisfy the major requirements for this application.
- The next generation magnets are expected to have $(BH)_m$ >100 MGOe

Kombination of nanoparticles high anizotropic magnetically hard materials (Nd – Fe – B) and magnetically soft materials (Fe).

Superhard plastic

There are in plastic matrix about 1 % of two dispersions :

- nanodiamond and carbon nanotubes
- nanodiamond and graphen - new

Synergic effect of both dispersions – fivefold increase of hardness and rigidity in comparison with one dispersion.

C/C composites

The current production is very expensive, used in aviation, rocketry, astronautics.

Cheaper replacement : prefabricat from C nanotubes is saturated with suspensions of nanoparticles C water based and then penetrated with phosphate ceramic particles.

Ship from nanocomposites

"Unmanned Surface Vessel"

plastic composite with carbon fibers and carbon nanotubes

http://en.wikipedia.org/wiki/Piranha_Unmanned_Surface_Vessel

Nobel Laureates in Physics 2007

Frenchman
Albert Fert, Paris university

German (native from Plzeň)
Peter Gruenberg,
KFA research institute, Julich, SRN

Essence of the Nobel price

Discovery of GMR – Giant Magnetoresistance

Independently discovered by two scientists in 1988

Quantum mechanical phenomenon in the nanocomposite of ferromagnetic and non-ferromagnetic metals

The application will take and patents

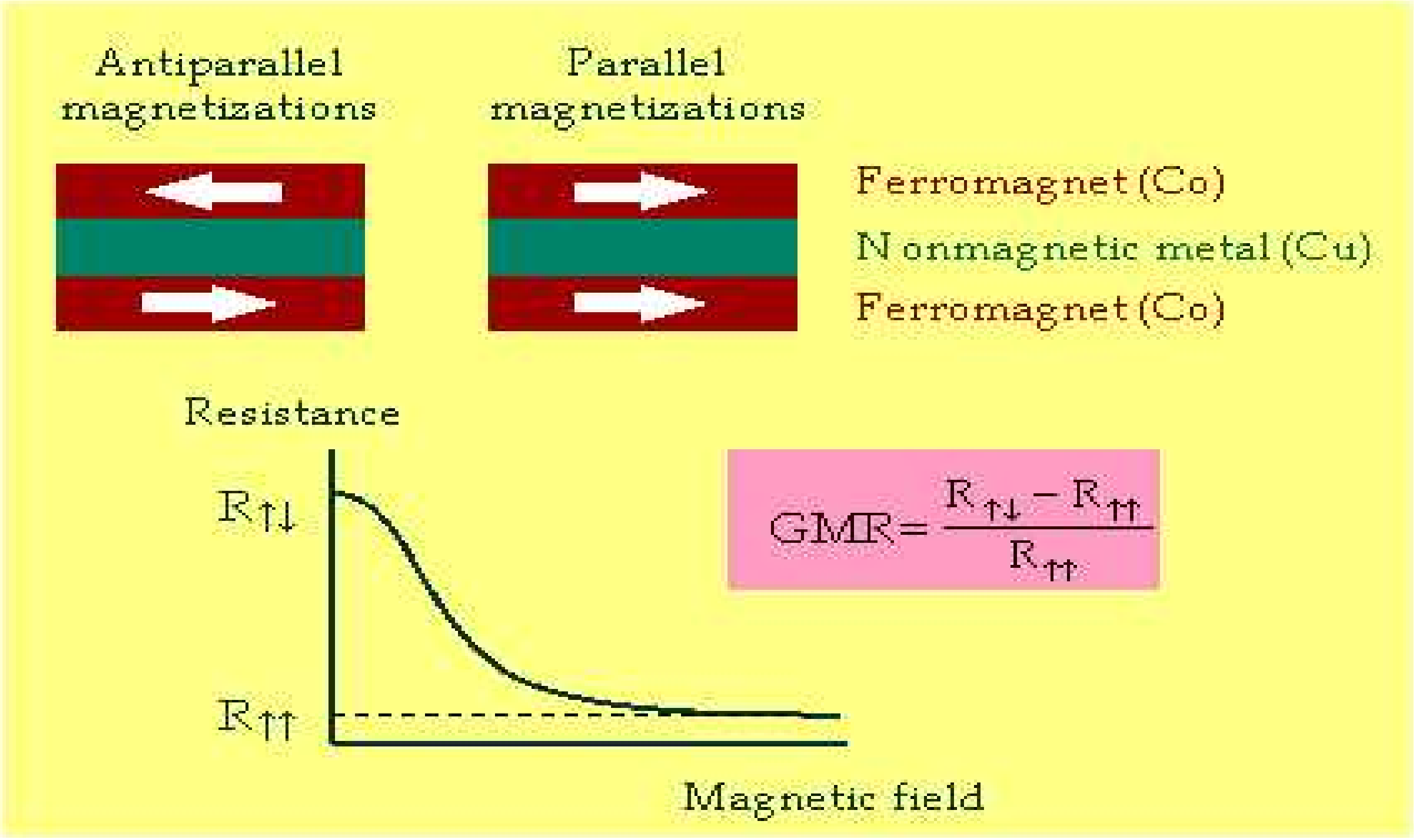
hold IBM 1997

The first hard drives with GMR heads

Nobel Prize 2007

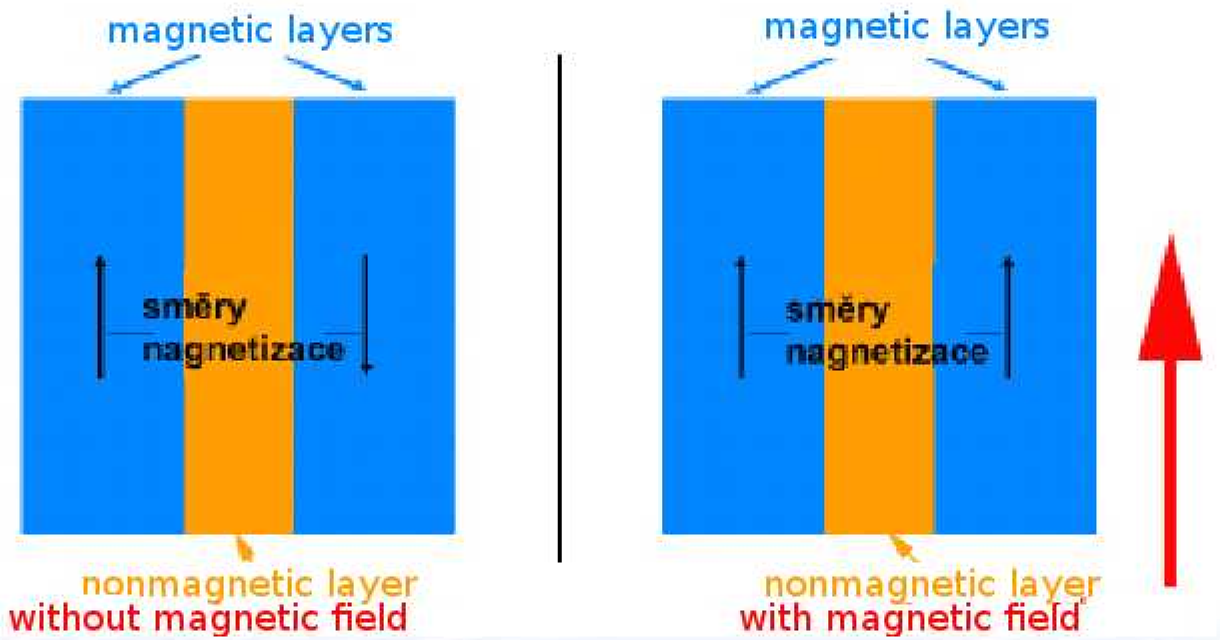
Main principal of GMR

giant change of resistance in magnetic field



Basic schema

It must be a nanostructure or nanocomposite
- that has simple domain structure
and critical scattering of electrons on the walls of layers



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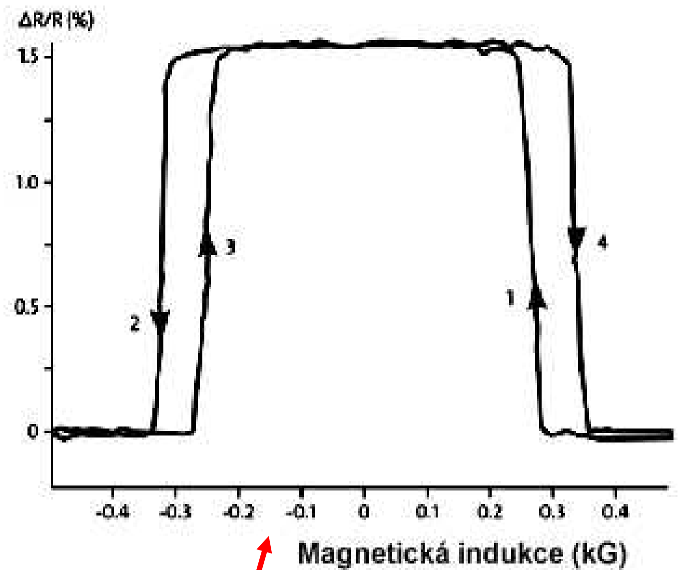
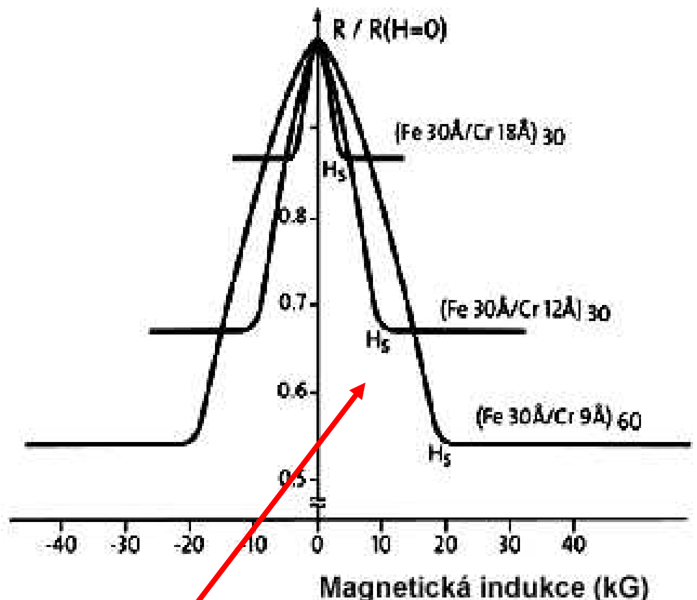
Basic GMR characteristics

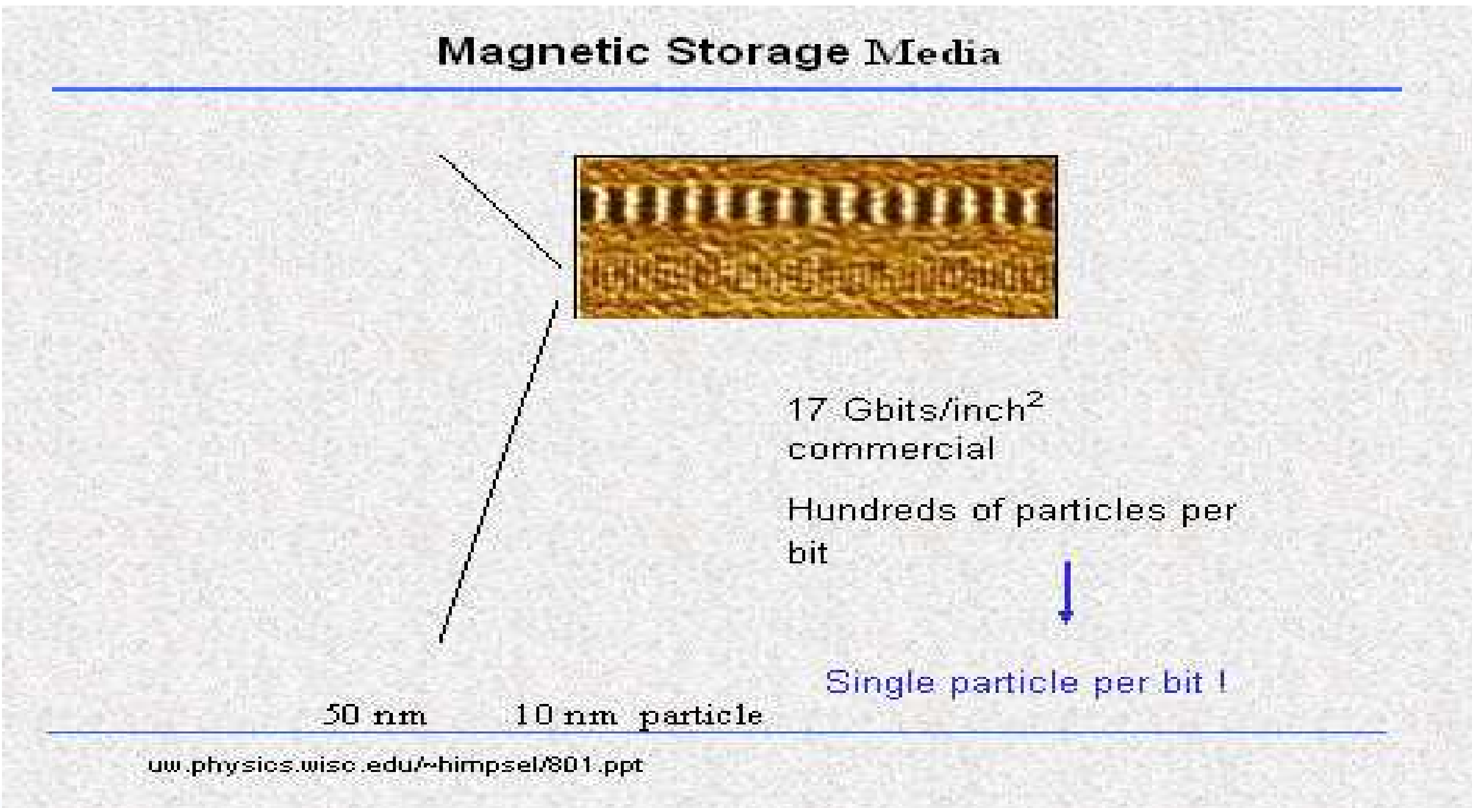




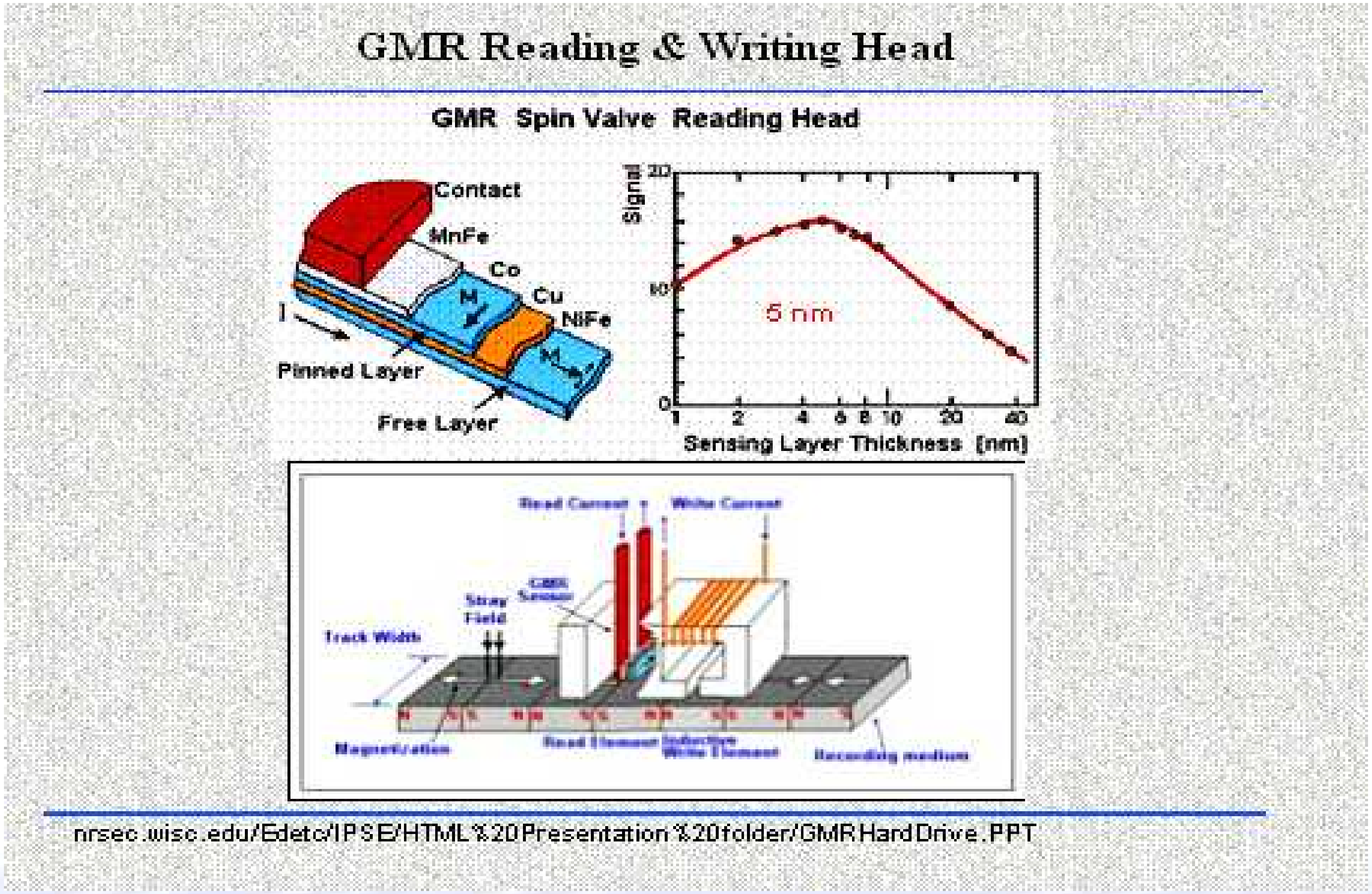
Simple systém of three layers

Composite system. Number is number of layers, 10 Å = 1 µm ,

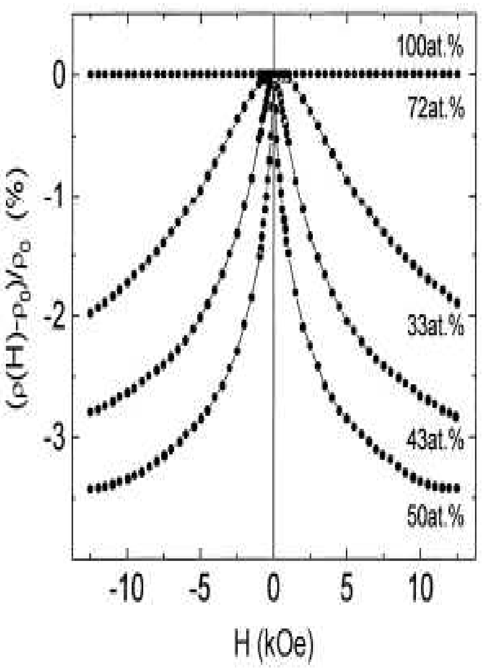
Today's hard drives and perspectives



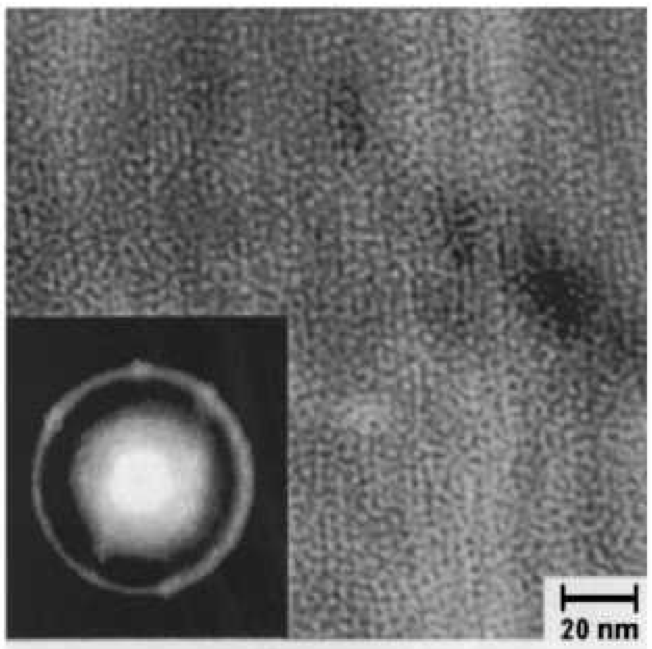
Today's construction of GMR head



New – particle nanocomposite – 2001, Russia, Voroněž



Magnetoresistance for $(Co_{41}Fe_{39}B_{20})_x(SiO_2)_{100-x}$ amorphous composites.



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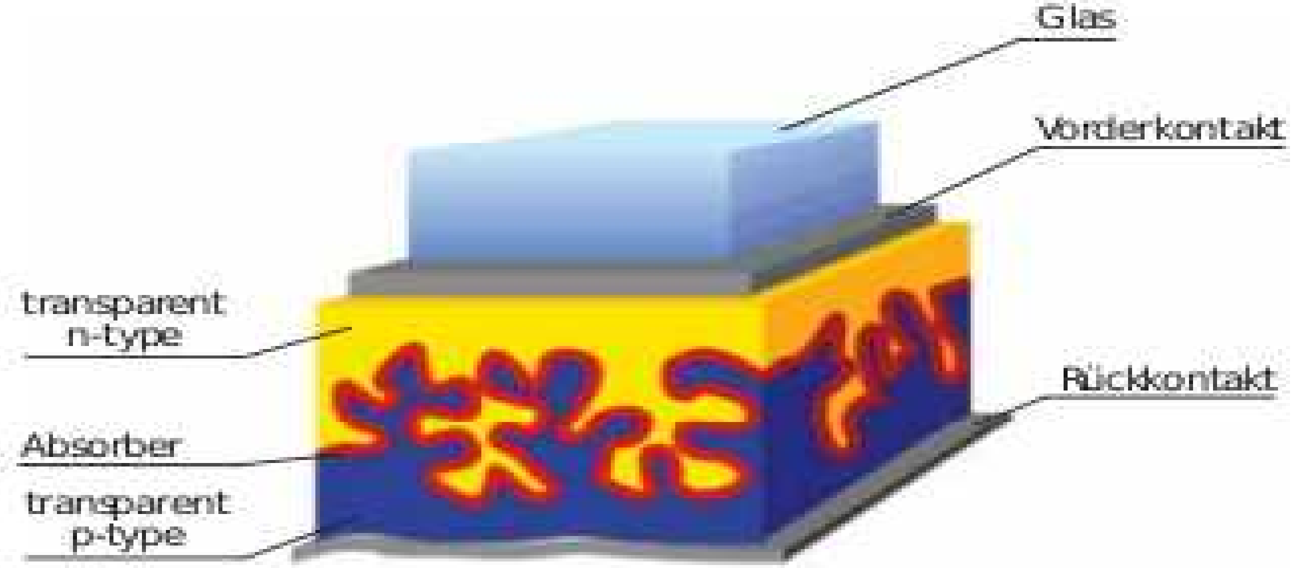
TEM microphotographs of $(Co_{41}Fe_{39}B_{20})_x(SiO_2)_{100-x}$ granular composites. The dark regions are the metal granules, the light regions are the SiO_2: (a) $(Co_{41}Fe_{39}B_{20})_{72}(SiO_2)_{28}$; (b) $(Co_{41}Fe_{39}B_{20})_{50}(SiO_2)_{50}$; (c) $(Co_{41}Fe_{39}B_{20})_{33}(SiO_2)_{67}$.

Nanocomposite – solar cell



10 nm tlhick layer of n- TiO_2.
Absorber PbS etc.
CuI as p – semiconductor.
TiO_2 and CuI are transparent.