研究スタッフ

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助　教：　小川　智之、技術職員：小野寺　政信
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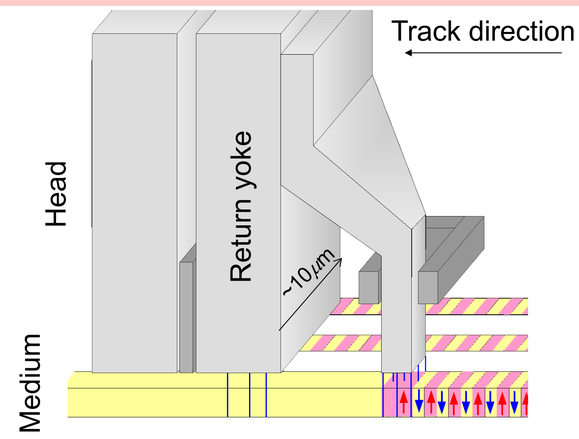
研究目的

本研究室では、スパッタ法を中心としたドライプロセスならびに化学合成を中心としたウェットプロセスを駆使することによって、超高密度磁気記録媒体、高性能・高感度を有するMRAM・SVヘッドおよび高周波デバイスを実現し得る、新たな材料設計・プロセス技術の確立を目指している。

HDD beyond 1 Tb/inch□



主な研究テーマ

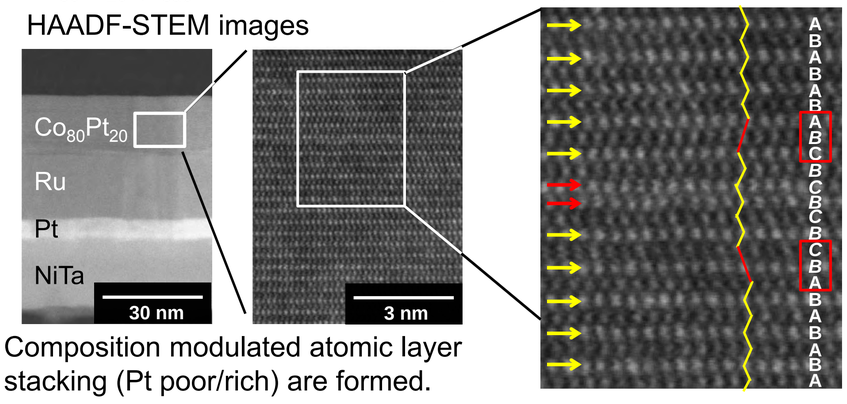
Media structure for perpendicular recording

In-line UHV sputtering machine

Composition modulated atomic layer stacking for high-K_u material

$Co_{80}Pt_{20}$ (T_{sub} = const. 300 °C, P_{Ar} = 2.0 Pa)

HAADF-STEM images



Composition modulated atomic layer stacking (Pt poor/rich) are formed.

HAADF-STEM

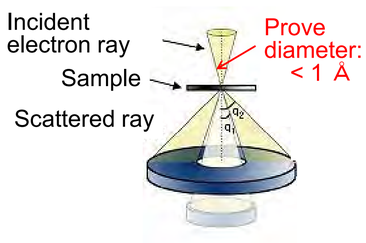
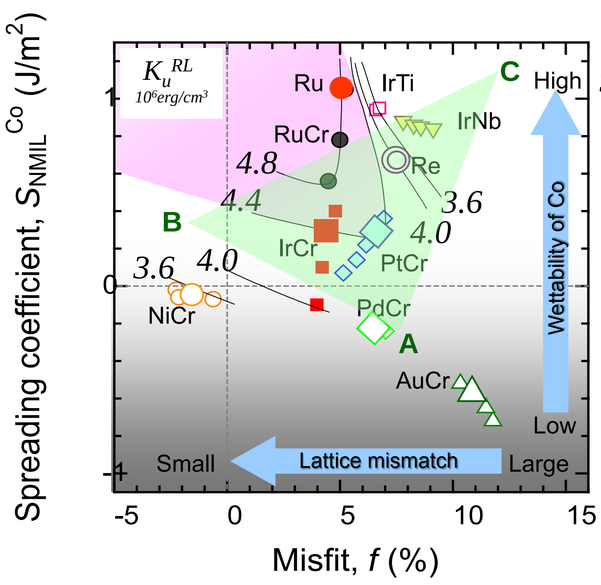
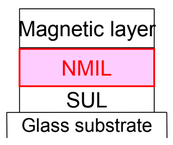


Image: Atom position + compositional contrast

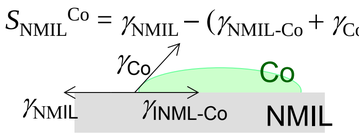
Fcc stacking as faults in macroscopic of hcp phase accompanies with irregularities for the periodicity of the compositional modulation

Alternative material to Ru





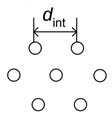
$S_{NMIL}^{Co} = \gamma_{NMIL} - (\gamma_{NMIL\text{-}Co} + \gamma_{Co})$



γ_{IL}: Surface energy of NMIL
γ_{Co}: Surface energy of Co
$\gamma_{nmil\text{-}Co}$: Boundary energy between NMIL-Co

A. R. Miedema and F. J. A. Broeder, Z. Metallkd., **70-1**, 14 (1979).
L. Z. Mezey and J. Giber, *Jpn. J. Appl. Phys.*, **21**, 1569 (1982).

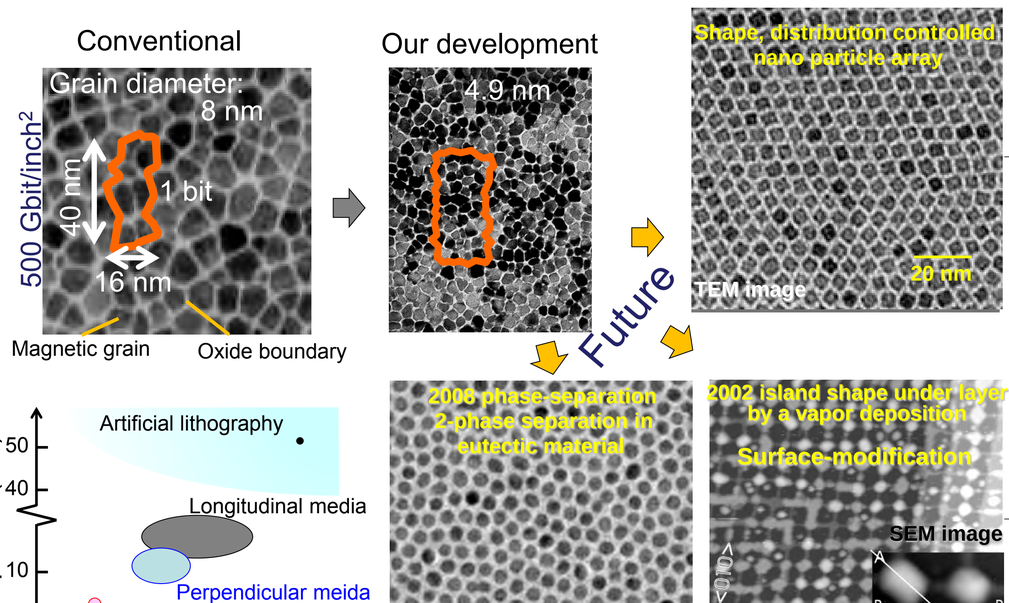
$f = (d_{int}^{NMIL} - d_{int}^{CoPtCr}) / d_{int}^{CoPtCr}$



d_{int}: nearest neighbor atom distance

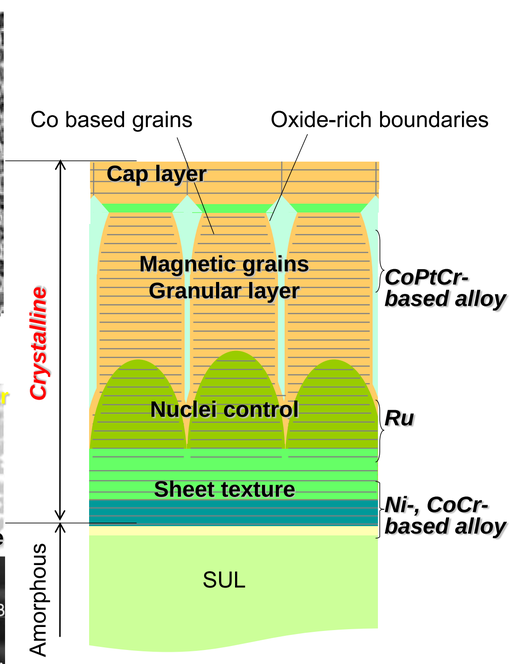
Key: Fcc with stacking faults, interface material design

Microstructure control



N. Yasui et al, Dr. thesis in Tohoku Univ (2008).

H. Ellmer et al., *Surf. Sci.*, **511**, 183 (2002).



Ordered-arrangement structure by a self-assemble phenomenon

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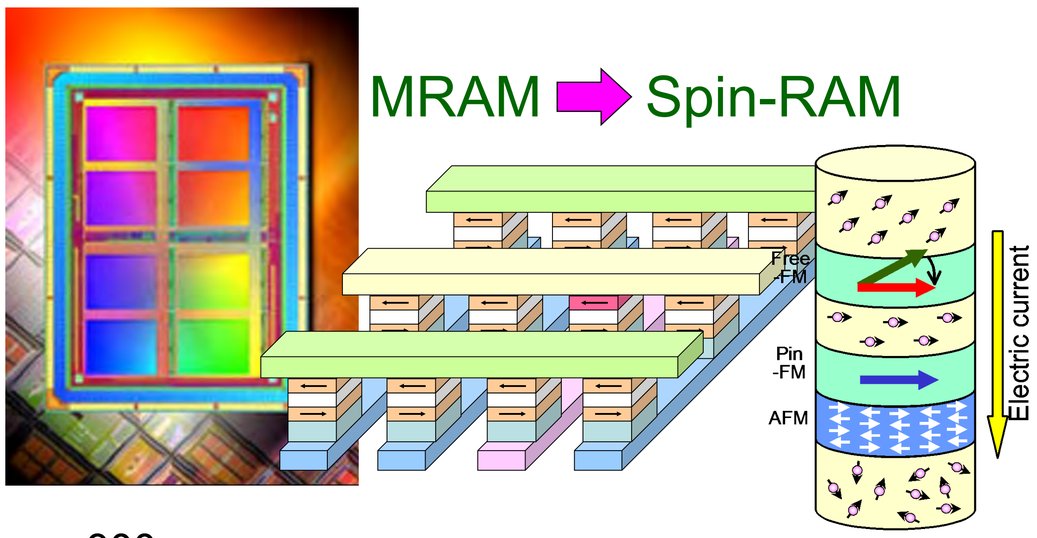
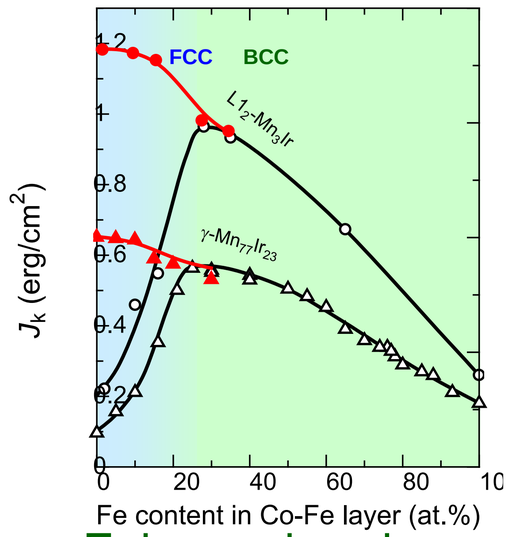
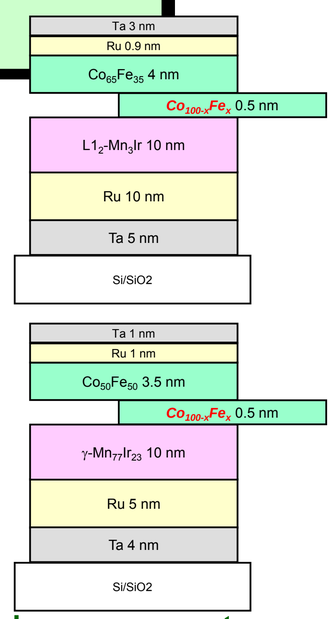
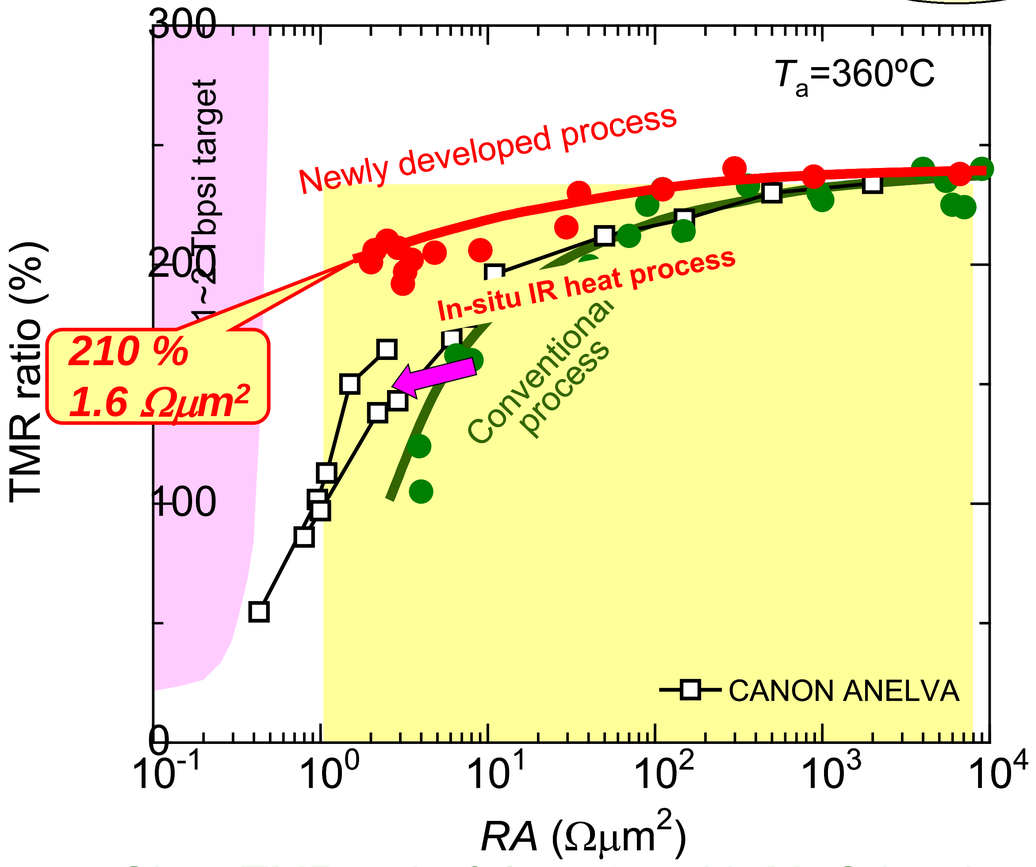
Spin nano technology for high performance magnetoresistive random access memory



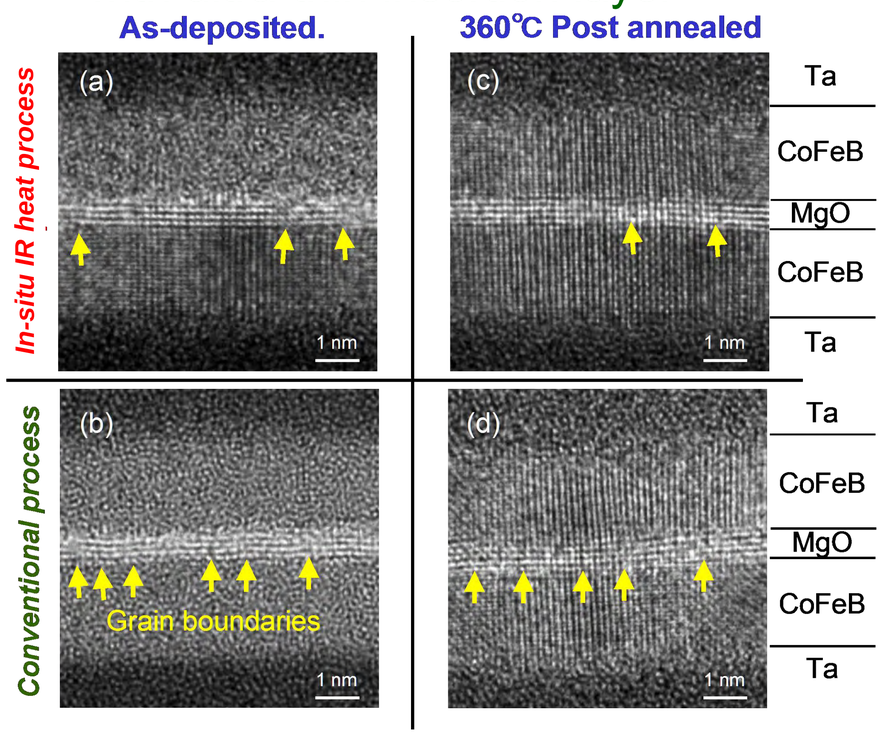






Giant TMR ratio & low *RA* with MgO barrier

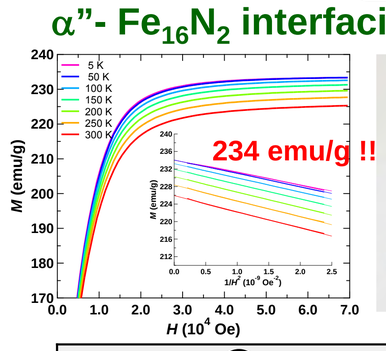
Enhanced exchange bias property with ultra-thin insertion layer

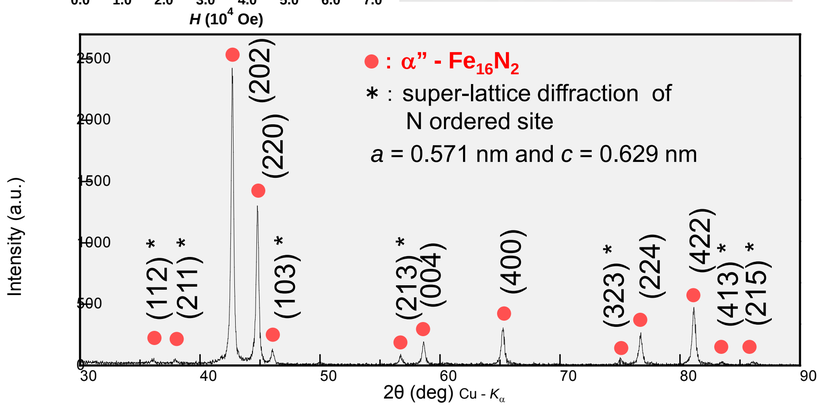


Promoting lateral grain size of the MgO barrier by the in-situ IR heat treatment

Fe-based magnetic nanoparticles for new magnetic devices

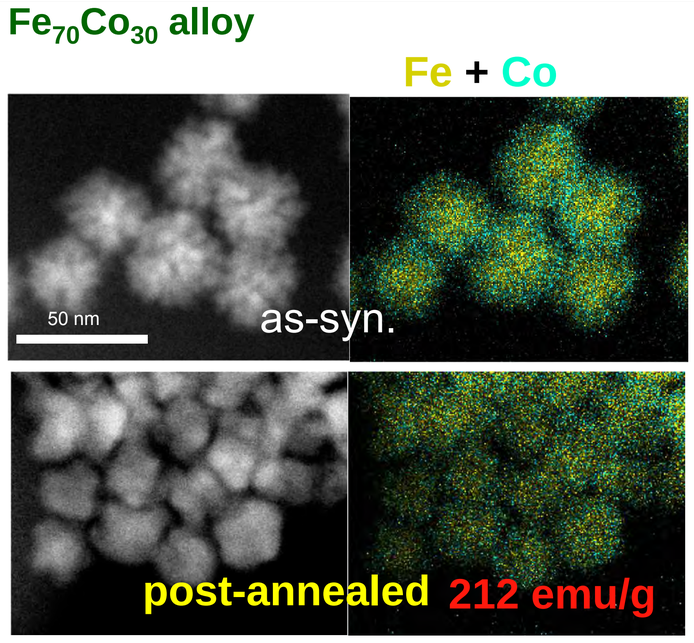
α"- $Fe_{16}N_2$ interfacial compound





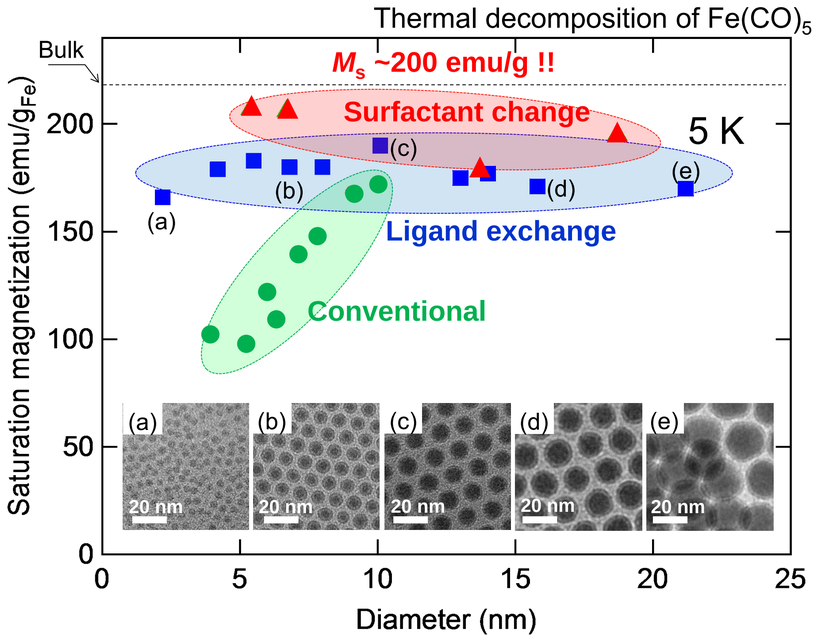
Single phase NPs formation with gram scale !!

$Fe_{70}Co_{30}$ alloy



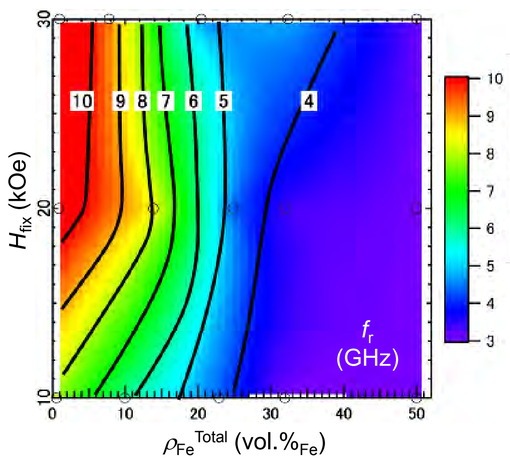
Homogeneous chemical composition !!

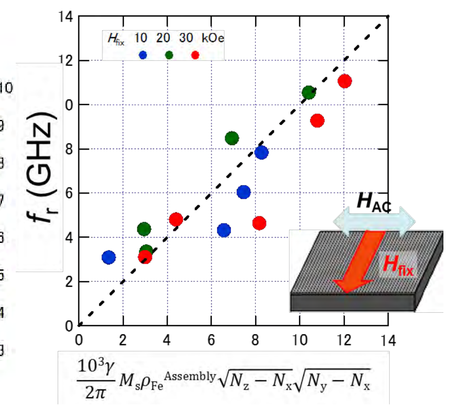
Pure Fe



Oxidization free Fe NPs!!

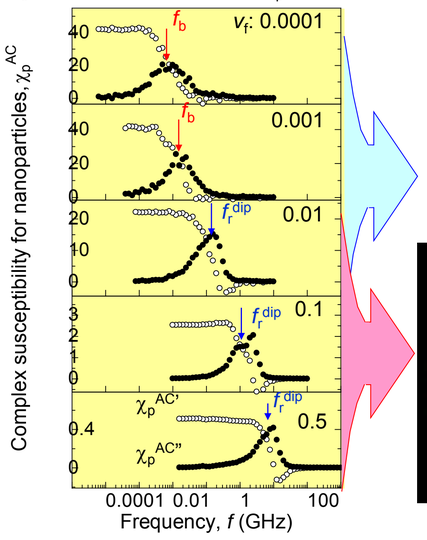
Challenge to GHz-band magnetic response

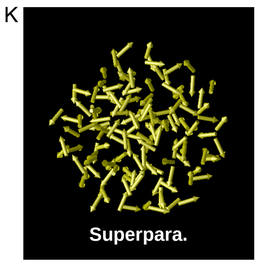


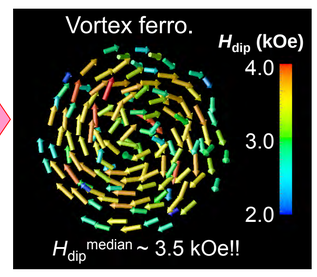


Estimated f_r from internal field originated from dipole field (GHz)

M_s: 1700 emu/cm^3, α: 0.1, D_p: 15 nm, T: 300 K



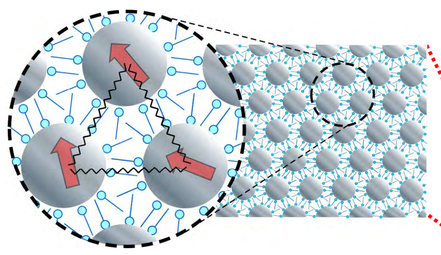




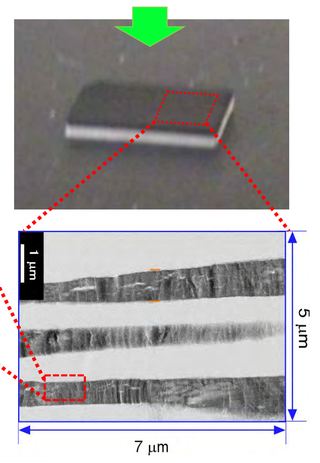
Strong dipole interaction field enhances f_r > 10 GHz !!

Compression molding

High controllability of NPs assembled structure !!



Hand press & Anneal in H_{fix}



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