

Short Review of the Last Two Years of Magnetic Carriers / 2012-2014

Urs Häfeli



urs.hafeli@ubc.ca

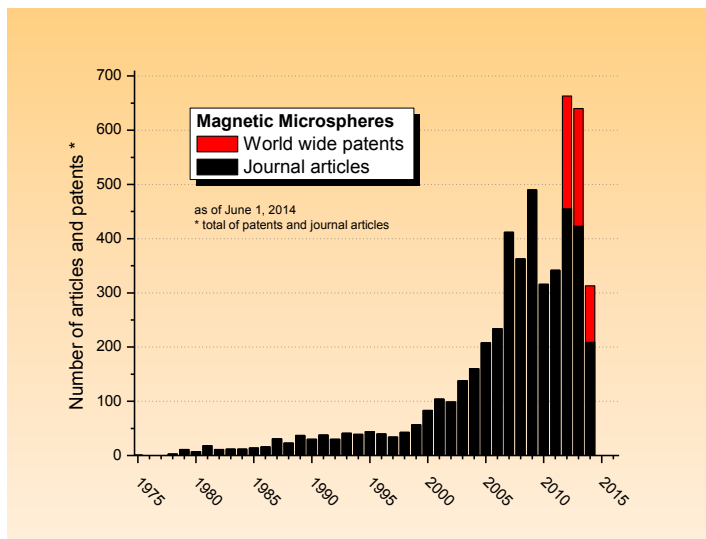
Number of Participants

Country	#	Country	#
1 Algeria	4	21 Japan	6
2 Argentina	1	22 Jordan	1
3 Australia	6	23 Latvia	1
4 Austria	4	24 Malaysia	1
5 Belarus	1	25 Netherlands	5
6 Brazil	2	26 Norway	1
7 Canada	6	27 Poland	4
8 China	4	28 Portugal	2
9 Czech Republic	18	29 Romania	5
10 Denmark	5	30 Russia	17
11 Egypt	1	31 Saudi Arabia	1
12 Finland	1	32 Slovakia	16
13 France	15	33 Slovenia	5
14 Germany	91	34 South Korea	3
15 Greece	4	35 Spain	16
16 Hungary	4	36 Sweden	4
17 India	3	37 Switzerland	12
18 Iran	1	38 Tanzania	1
19 Ireland	2	39 Turkey	1
20 Italy	1	40 UK	11
		41 USA	39

> 326 Participants from 41 Countries !

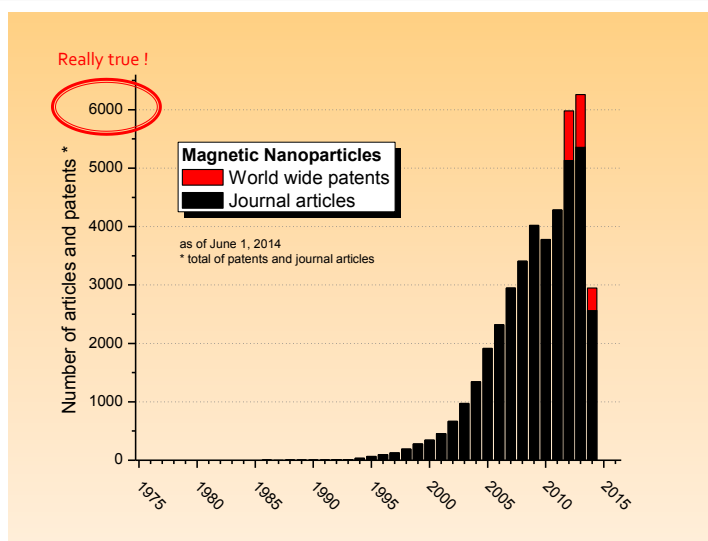
Journal Update:

Is Publishing about Magnetic Micropheres Still Trendy ?



Journal Update:

Publishing about Magnetic Nanoparticles, That's Trendy !



DISCLAIMER

- This presentation might be very incomplete, opinionated, one-sided, and might NOT mention your research
- But that's why you all have to stay around for the next 4 days ...

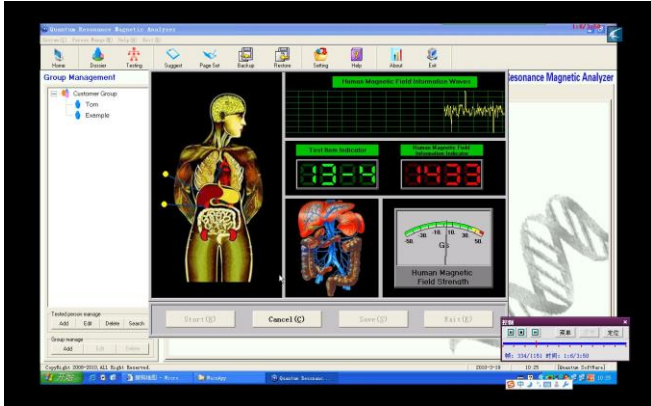


Magnetic Shampoo



6

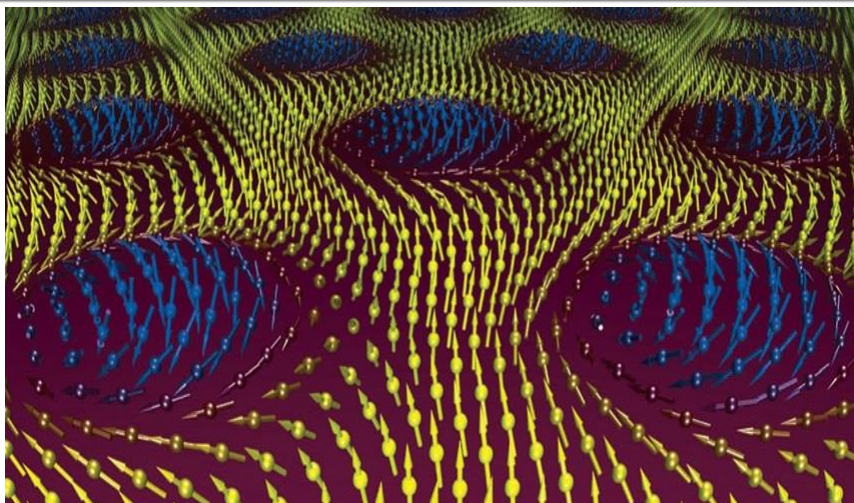
Amazing New Quantum Analyzers



7

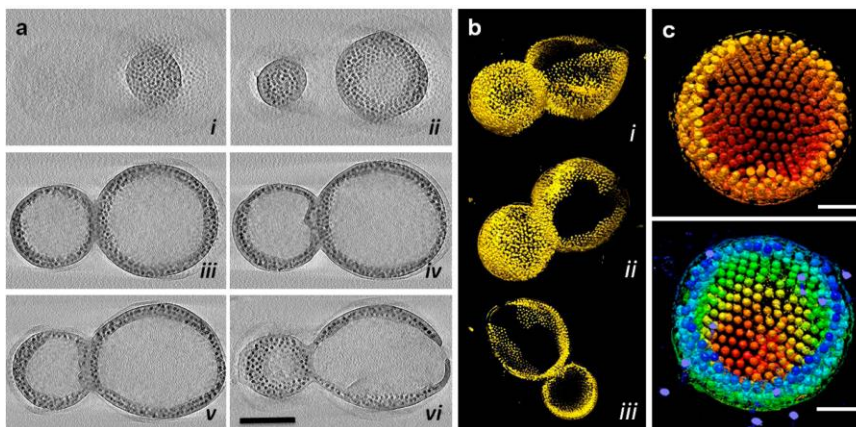
Synthesis

Skyrmions Made Me Squirm



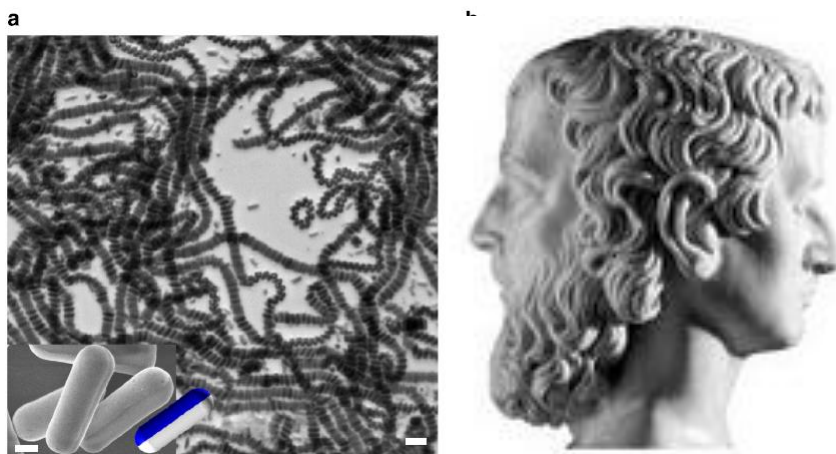
Felser C (2013). *Skyrmions*. *Angew Chem Int Ed Engl* 52, 1631-1634.

Self-Assembled Polymersomes



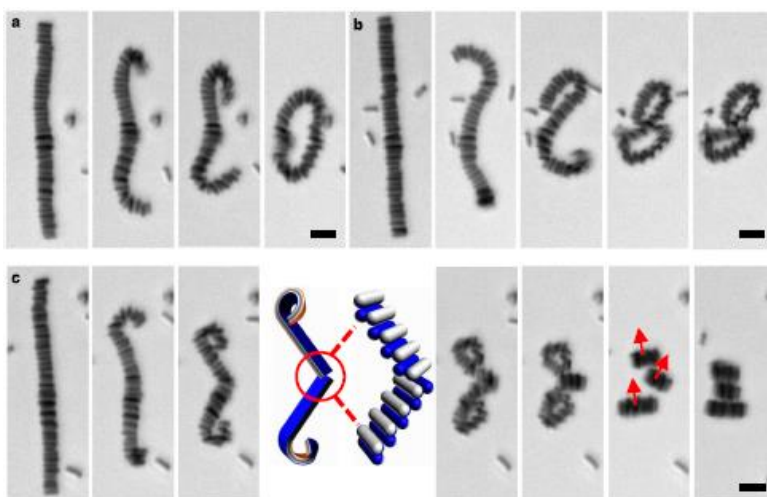
Hickey RJ, Koski J, et al. (2014). *ACS Nano* 8, 495-502.

Colloidal Ribbons and Rings from Janus Magnetic Rods



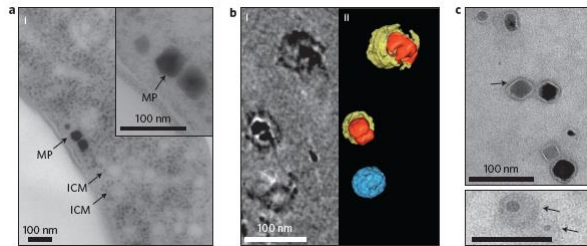
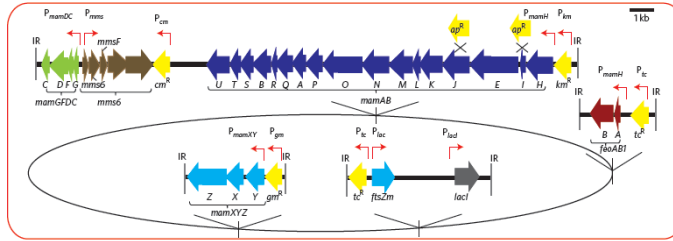
Yan J, Chaudhary K, et al. (2013). *Nature communications* 4, 1516.

Colloidal Ribbons and Rings from Janus Magnetic Rods



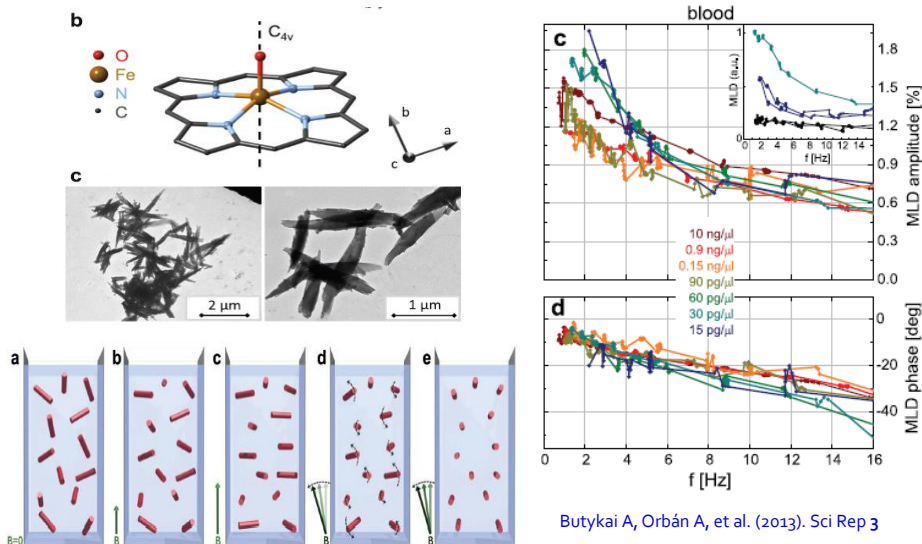
Yan J, Chaudhary K, et al. (2013). *Nature communications* 4, 1516.

Biosynthesis of Magnetic Nanostructures in a Foreign Organism



Kolinko I, Lohse A, et al. (2014). *Nat Nano* 9, 193-197.

Malaria Pigment Crystals as Magnetic Micro-Rotors: Key for High-Sensitivity Diagnosis

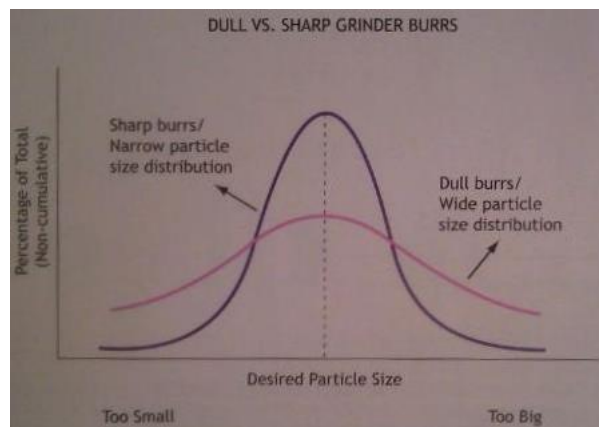


Butykai A, Orbán A, et al. (2013). *Sci Rep* 3

Importance of Particle Size

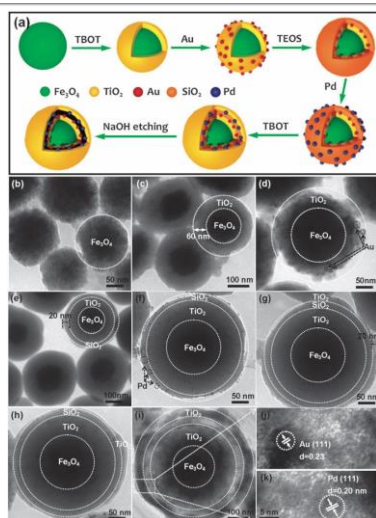


Importance of Particle Size



Coating

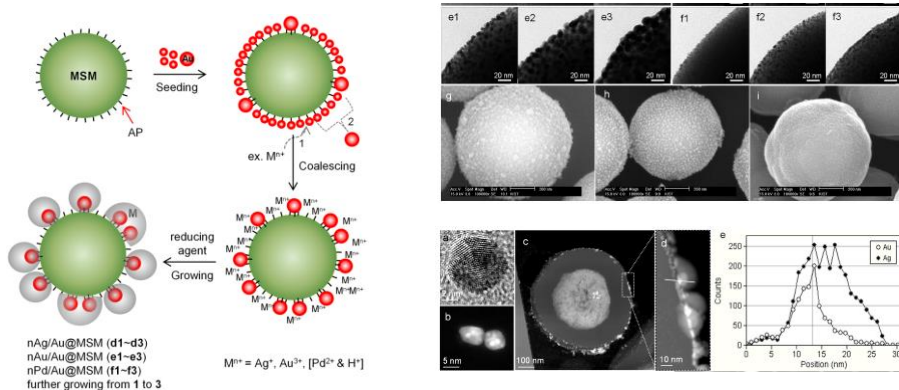
Layered Approach to the Max



- Reusable catalyst with high activity and stability for reduction of 4-nitrophenol and Suzuki-Miyaura coupling reaction of aryl iodides
- 100% of reduction in 4 minutes

Hu W, Liu B, Wang Q, Liu Y, Liu Y, Jing P, et al. A magnetic double-shell microsphere as a highly efficient reusable catalyst for catalytic applications. *Chemical Communications*. 2013;49(69):7596-8.

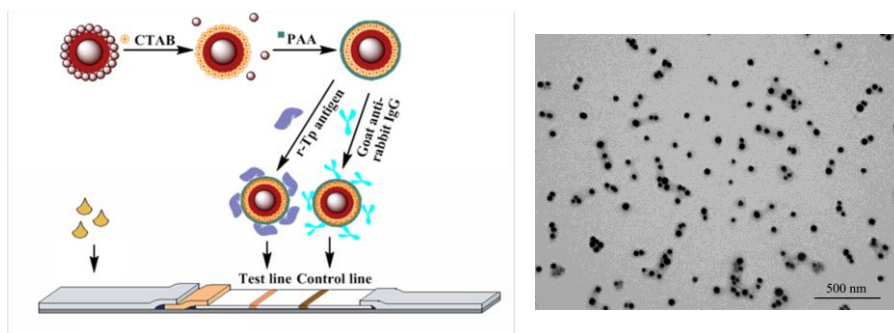
Core-Shell Bimetallic Nanoparticles Robustly Fixed on the Outermost Surface of Magnetic Silica Microspheres



MSM = magnetic silica microspheres

Park HH, Woo K, Ahn J-P (2013). *Sci Rep* 3

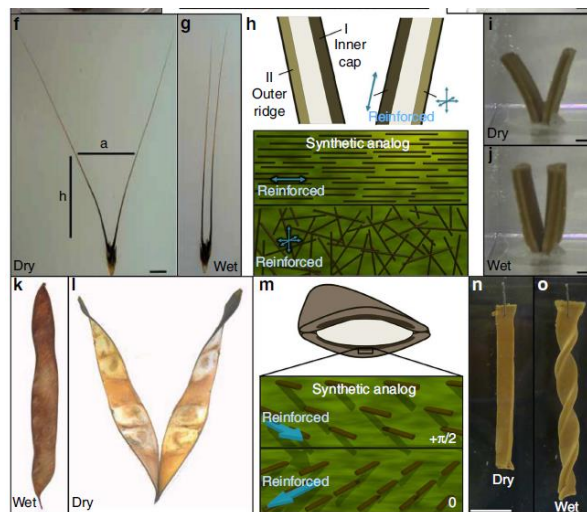
Polyelectrolyte Coated Gold Magnetite Nanoparticles for Syphilis Immunoassay



Yang D, Ma J, et al. (2013). *Analytical Chemistry* 85, 6688-6695.

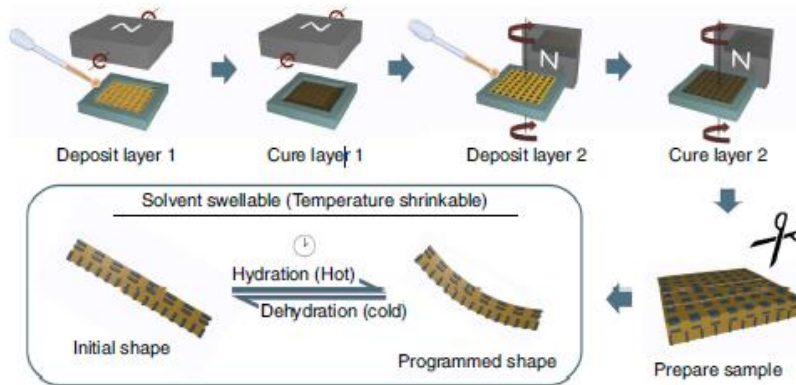
Technical Applications

Self-Shaping Composites with Programmable Bioinspired Microstructures



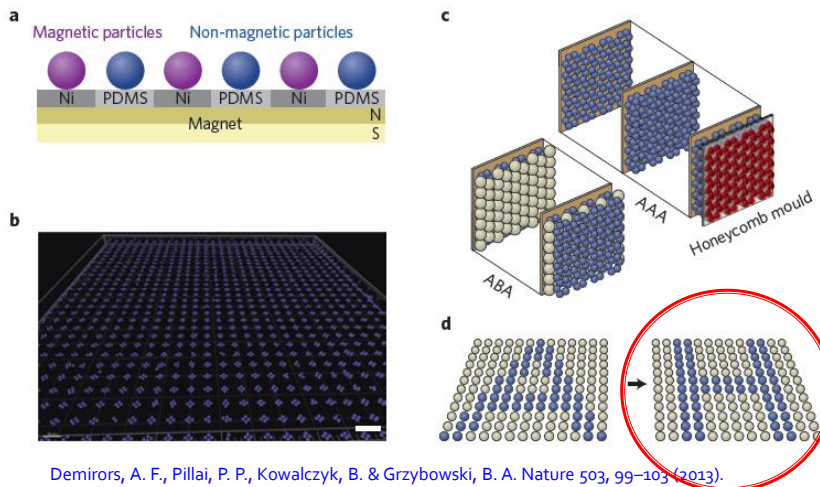
Erb RM, Sander JS, et al. (2013). Nature communications 4, 1712.

Self-Shaping Composites with Programmable Bioinspired Microstructures



Erb RM, Sander JS, et al. (2013). Nature communications 4, 1712.

Printing with Magnets

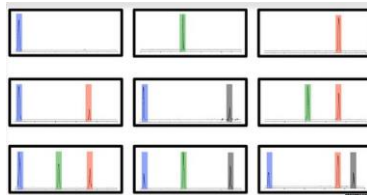
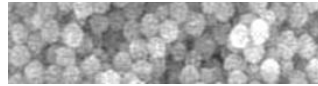


Demirors, A. F., Pillai, P. P., Kowalczyk, B. & Grzybowski, B. A. Nature 503, 99–103 (2013).

Yu C, Zhang J, Granick S (2014). Nat Mater 13, 8-9.

Invisible Barcode

- An invisible barcode is being developed to track explosives, medicines and bank notes
- Based on nanoparticles that can be read out, even after explosions (TNT)



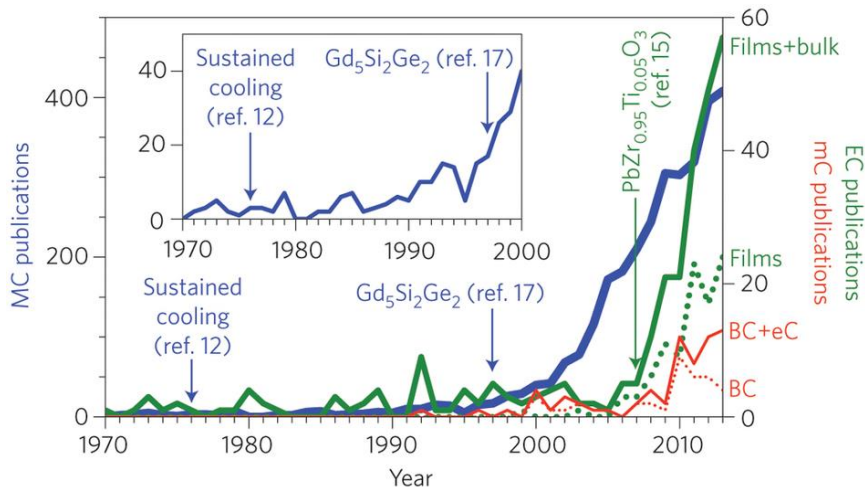
Ming Su, Worcester Polytechnic Institute

Magnetocaloric Effect (MC)



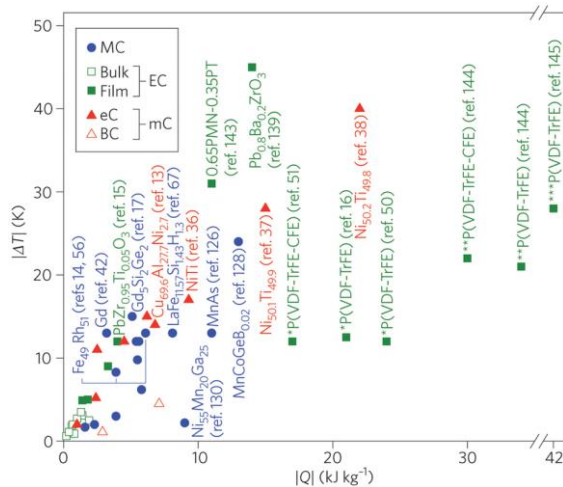
X. Moya, S. Kar-Narayan & N. D. Mathur (2014) Nature Materials 13, 439–450

Magnetocaloric Effect (MC)



X. Moya, S. Kar-Narayan & N. D. Mathur (2014) Nature Materials 13, 439–450

Magnetocaloric Effect (MC)



X. Moya, S. Kar-Narayan & N. D. Mathur (2014) Nature Materials 13, 439–450

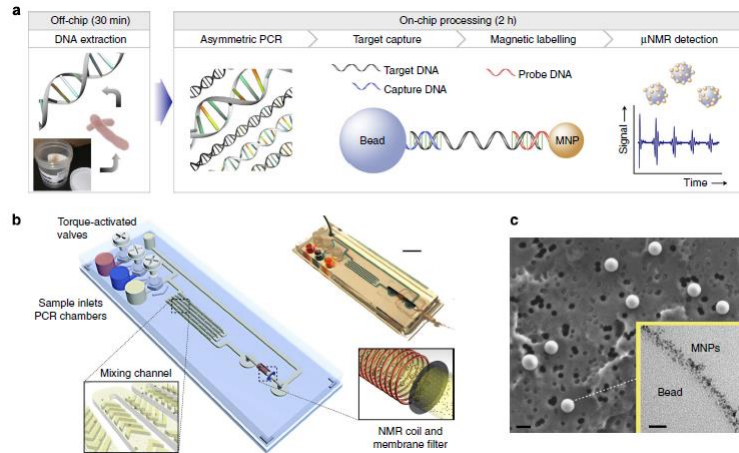
Biological Applications

This Year's Tutorial: Biology for the Physicist, Chemist and Engineer

- **Joachim Clement, Ph.D.**
Tumour Biology and Nanomaterials Group, Dept. Hematology and Oncology, University Hospital, Friedrich Schiller University, Jena, Germany
- *A handout containing all relevant information about this lecture series will be a part of the abstract booklet.*

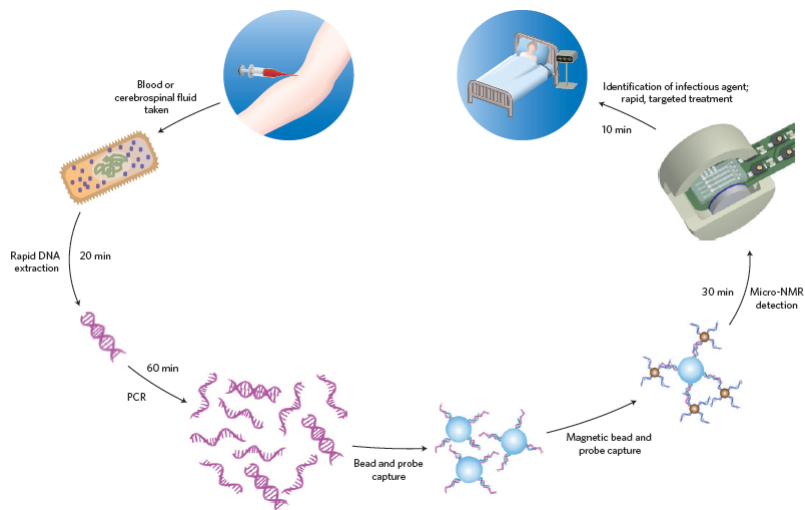


Magnetic Barcode Assay for Genetic Detection of Pathogens



Liong M, Hoang AN, et al. (2013). Nature communications 4, 1752.

Magnetic Sensors: Nanoparticles Detect Infection



McNally A (2013). Nat Nano 8, 315-316.

A Magneto-DNA Nanoparticle System for Rapid Detection and Phenotyping of Bacteria

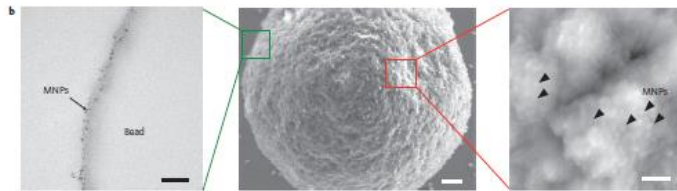
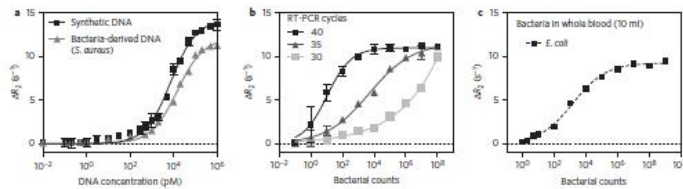
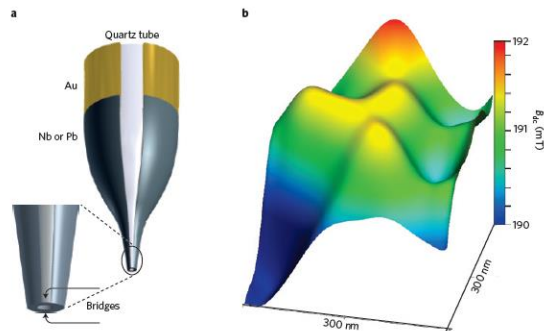


Figure 1 | Magneto-DNA assay for the detection of bacterial 16S rRNA. **a**, Schematic of the assay procedure. Total RNA is extracted from the specimen, and the 16S rRNA is amplified by asymmetric RT-PCR. Single-strand DNA of the amplified product is then captured by beads conjugated to capture probes, before hybridizing with MNPs to form a magnetic sandwich complex. Samples are subsequently analyzed using a μ NMR system. **b**, Hybridized probe complexes, as observed by transmission electron microscopy (left; scale bar, 100 nm), scanning electron microscopy (centre; scale bar, 300 nm), and atomic force microscopy (right; scale bar, 100 nm).



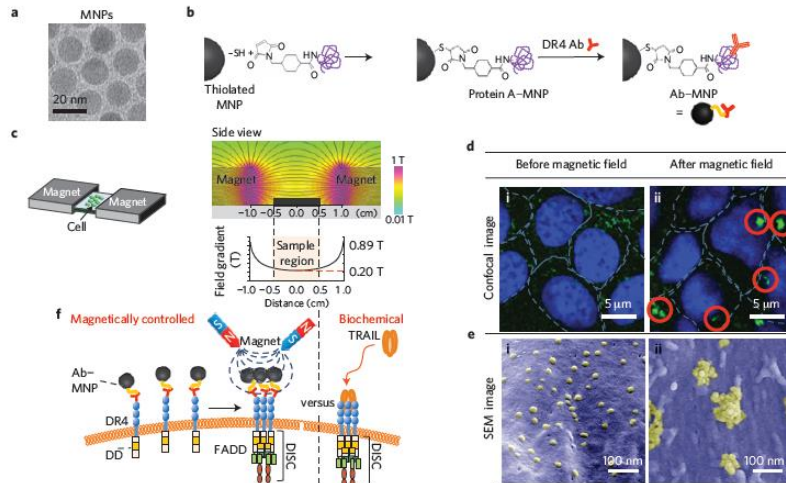
Chung HJ, Castro CM, et al. (2013). *Nat Nano* 8, 369-375.

Magnetic Sensors: A Tip for Better Sensing in SQUID



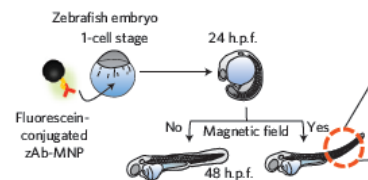
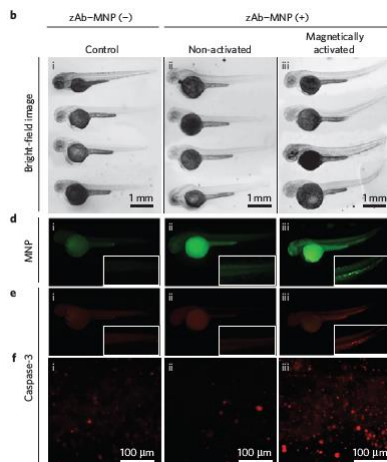
Koelle D (2013). *Nat Nano* 8, 617-618.

Magnetic Switch to Control Cell Death Signalling in *in vitro* and *in vivo* Systems



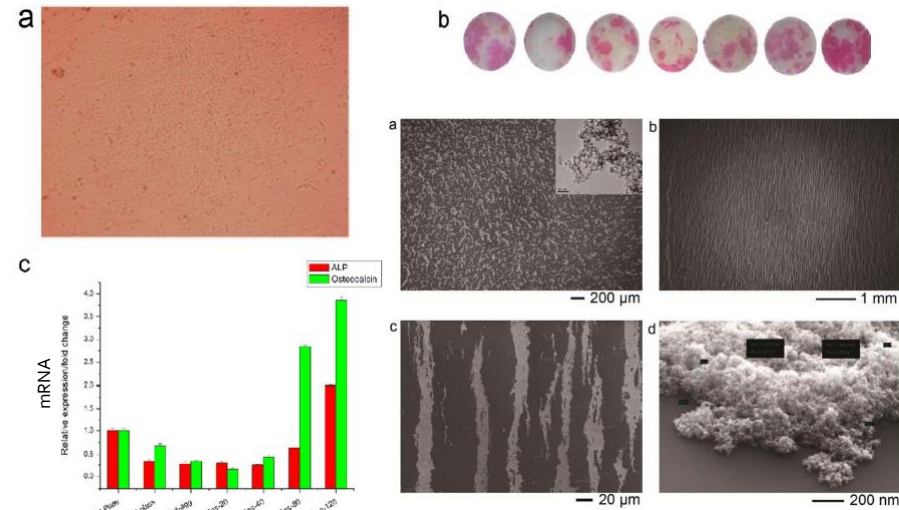
Cho MH, Lee EJ, et al. (2012). *Nat Mater* **11**, 1038-1043.

Magnetic Switch to Control Cell Death Signalling in *in vitro* and *in vivo* Systems



Cho MH, Lee EJ, et al. (2012). *Nat Mater* **11**, 1038-1043.

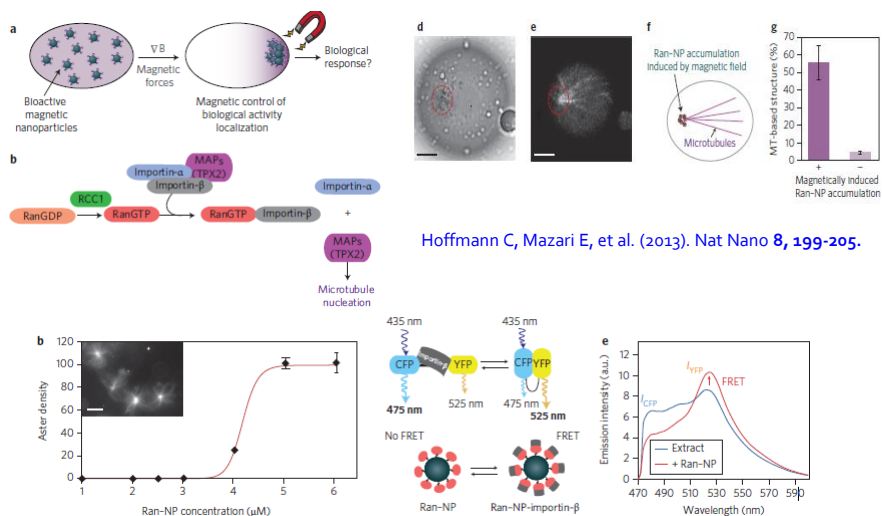
Magnetic Assembly-Mediated Enhancement of Differentiation of Mouse Bone Marrow Cells



- Primary mouse bone marrow cells

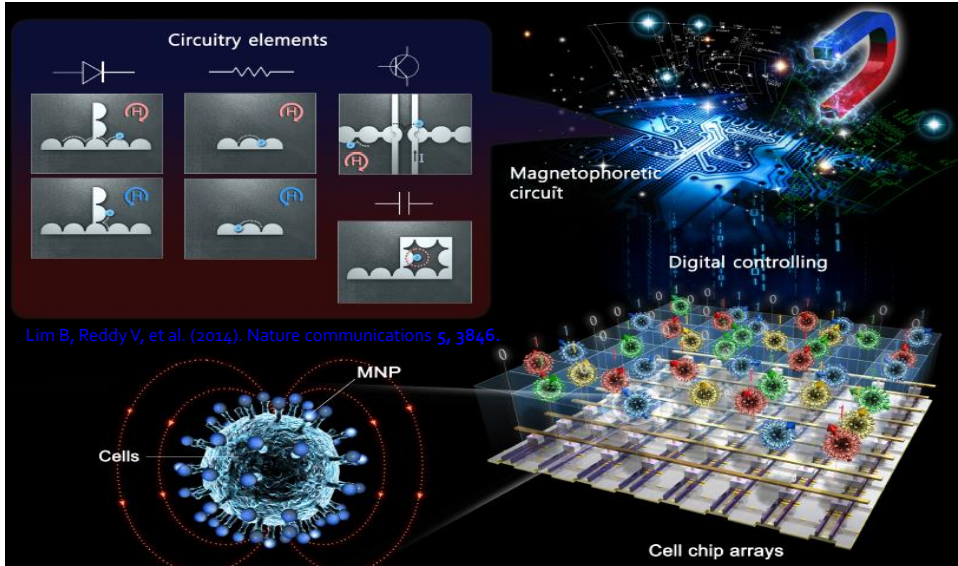
Sun J, Liu X, et al. (2014). *Sci Rep* 4

Spatiotemporal Control of Microtubule Nucleation and Assembly with Magnetic Nanoparticles

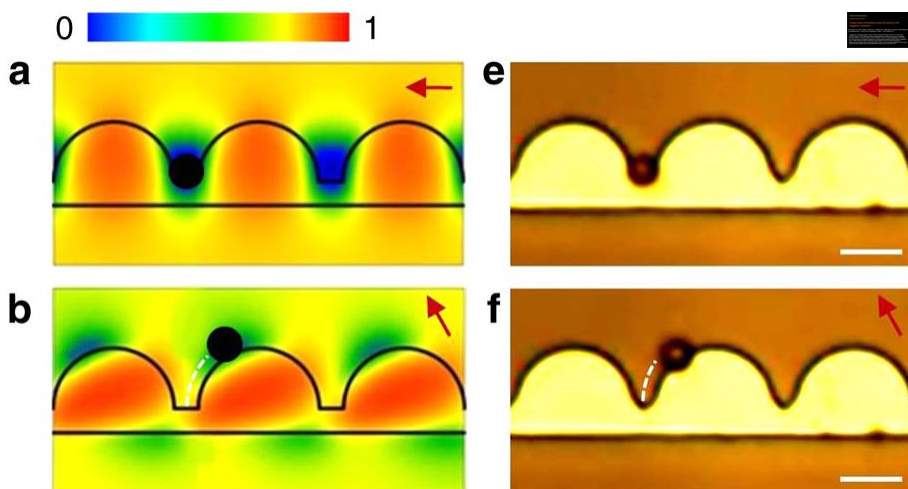


Hoffmann C, Mazari E, et al. (2013). *Nat Nano* 8, 199-205.

Magnetophoretic Circuits to Control Single Particles and Cells



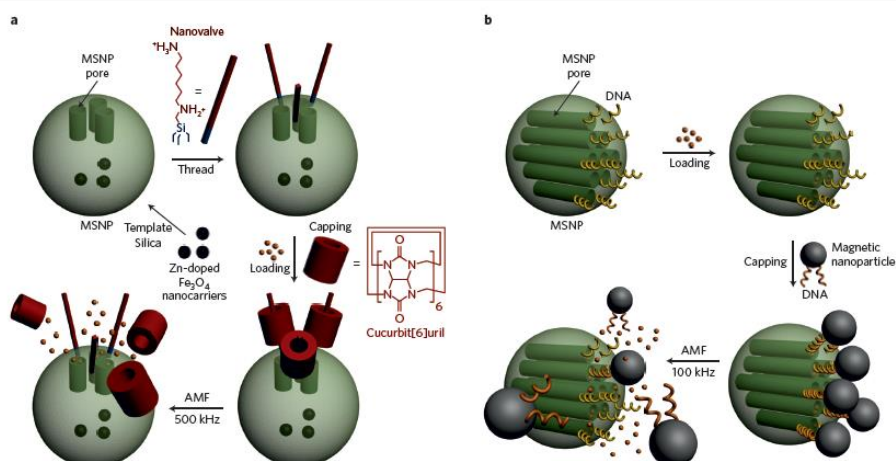
Magnetophoretic Circuits to Control Single Particles and Cells



Lim B, Reddy V, et al. (2014). Nature communications 5, 3846.

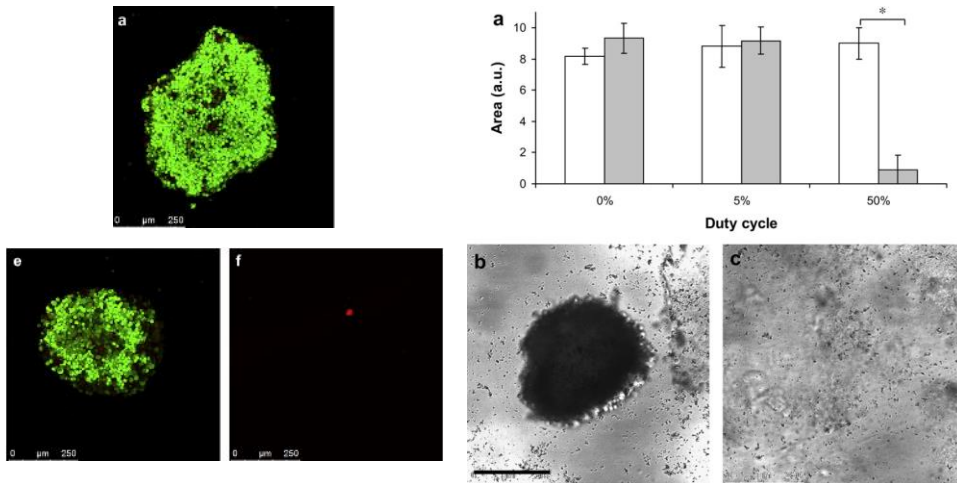
Medical Applications

Magnetically Actuated Drug Release



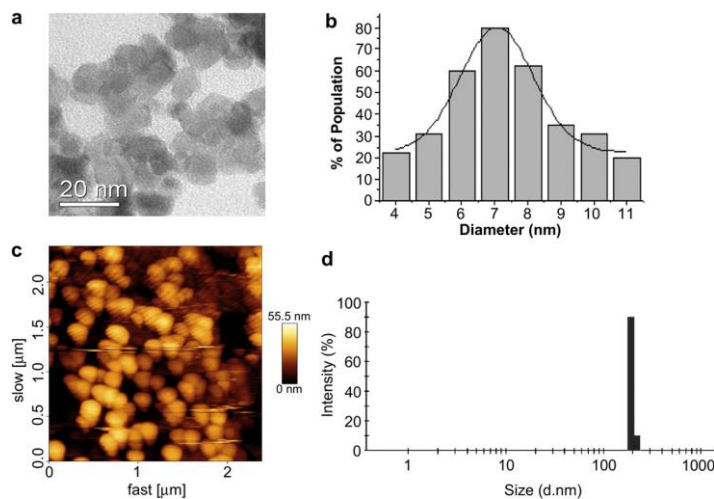
Mura S, Nicolas J, Couvreur P (2013). *Nat Mater* **12**, 991-1003.

Destruction of Spheroids with Magnetic Nanoparticles using Ultrasound



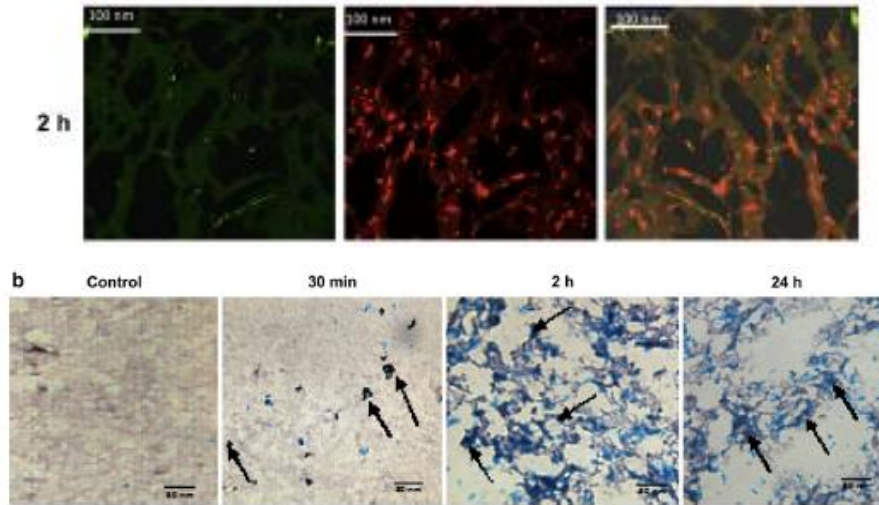
Ho VHB, Smith MJ, Slater NKH (2011). *Ultrasound in Medicine & Biology* 37, 169-175.

Delivery of Paclitaxel Magnetic Particles Across the Blood Brain Barrier



Dilnawaz F, Singh A, et al. (2012). *Biomater* 33, 2936-2951.

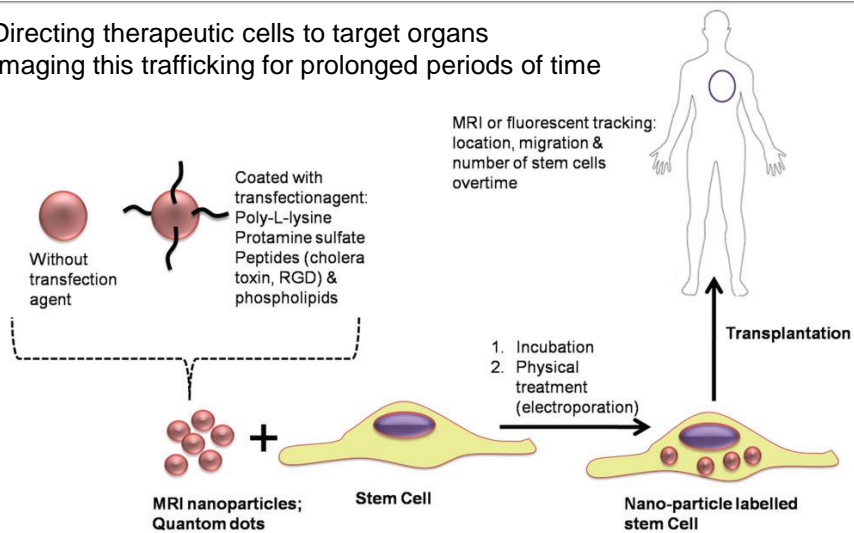
Delivery of Paclitaxel Magnetic Particles Across the Blood Brain Barrier



Dilnawaz F, Singh A, et al. (2012). *Biomater* 33, 2936-2951.

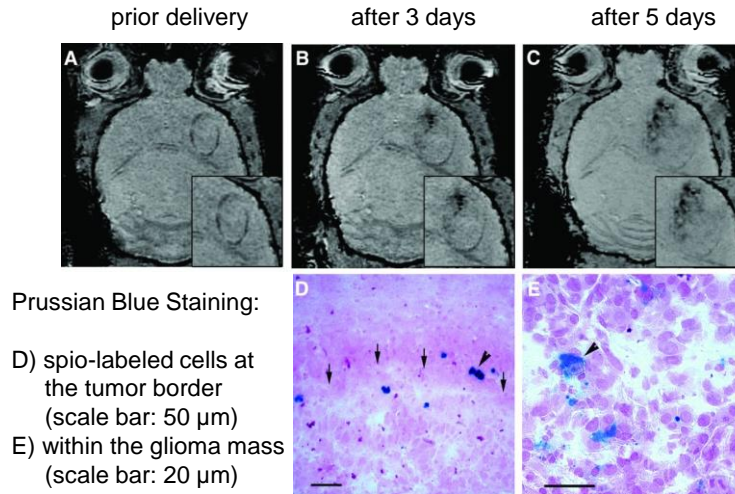
Specific Identification of Stem Cells

- Directing therapeutic cells to target organs
- Imaging this trafficking for prolonged periods of time



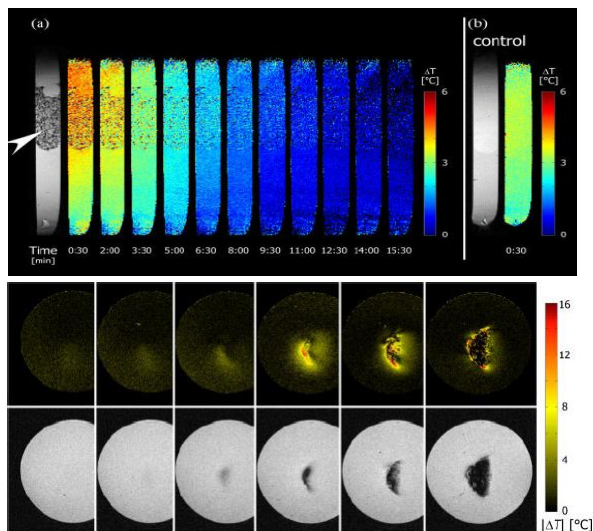
I. Wimpenny et al. *Stem Cell Research & Therapy* 2012, 3,13

Intranasal Delivery of Neural Stem / Progenitor Cells: a Noninvasive Passage to Target Glioma



Reitz M, Demestre M, et al. (2012). *Stem cells translational medicine* **1**, 866-73.

Specific Identification of Stem Cells using Magnetic Field Hyperthermia and MR Thermometry



Haddad D, Hildenbrand MF, et al. (2012). *NMR Biomed* **25**, 402-9.

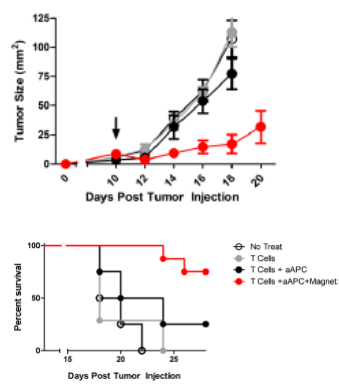
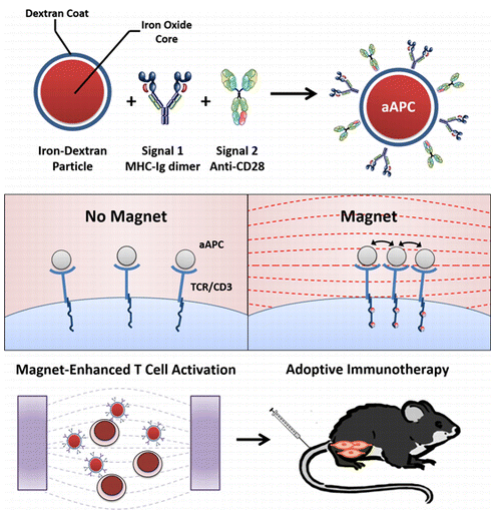
Breakthrough of the Year 2013




New antibody therapies are stimulating the immune system to destroy cancer cells.

J Couzin-Frankel Science 2013;342:1432-1433

Magnetic T-Cell Clustering Produces Immune Response



Perica K, Tu A, et al. (2014). ACS Nano 8, 2252-2260.

There is Much More



... from your colleagues during the next few days here at the meeting !

And don't forget to check (and contribute) to our website:

<http://www.magneticmicrosphere.com>

Thank You



- Exhibitors
- Sponsors
 - Travel Grants
- Reviewers
- Participants