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SelfSys RTD 2009

FNSNF

Towards Magnetically Guided Self-Assembly

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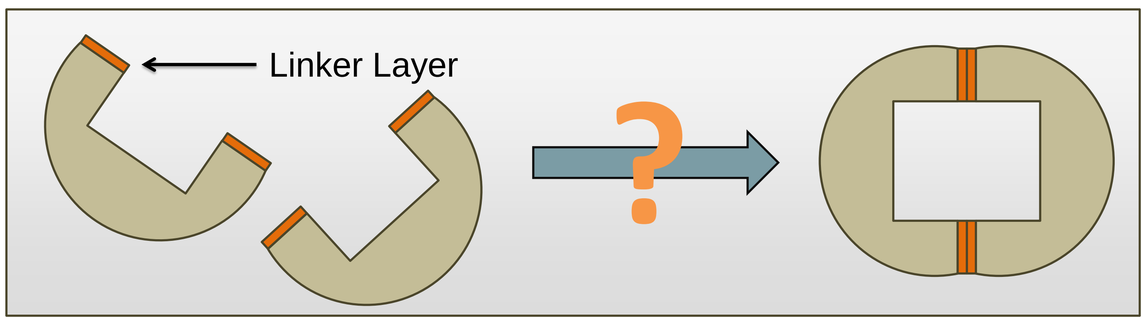
Motivation



Hydrophobic / hydrophilic self-assembly

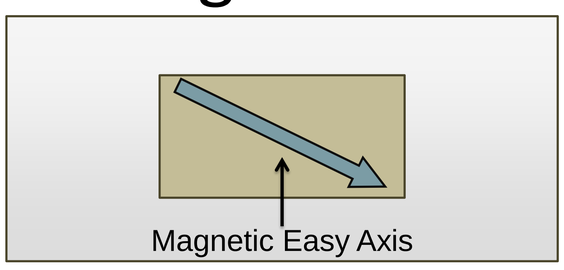
+ Selective, permanent assembly demonstrated in SelfSys framework, yield 98% [1]
- Stochastic, irreversible process, disassembly only due to mechanical impact

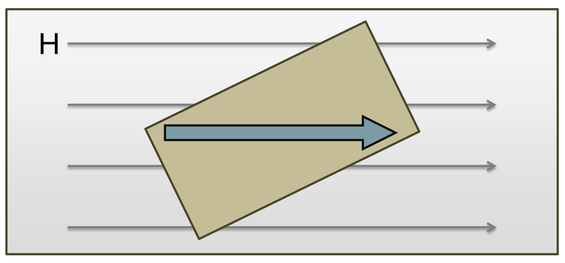
Linker layer based self-assembly

+ Intelligent linker sensitive to environment, system can disassemble due to external trigger
- During assembly linker layers are required to be in defined contact to allow for sufficient interaction

Magnetic guiding provides a solution to this problem

Background

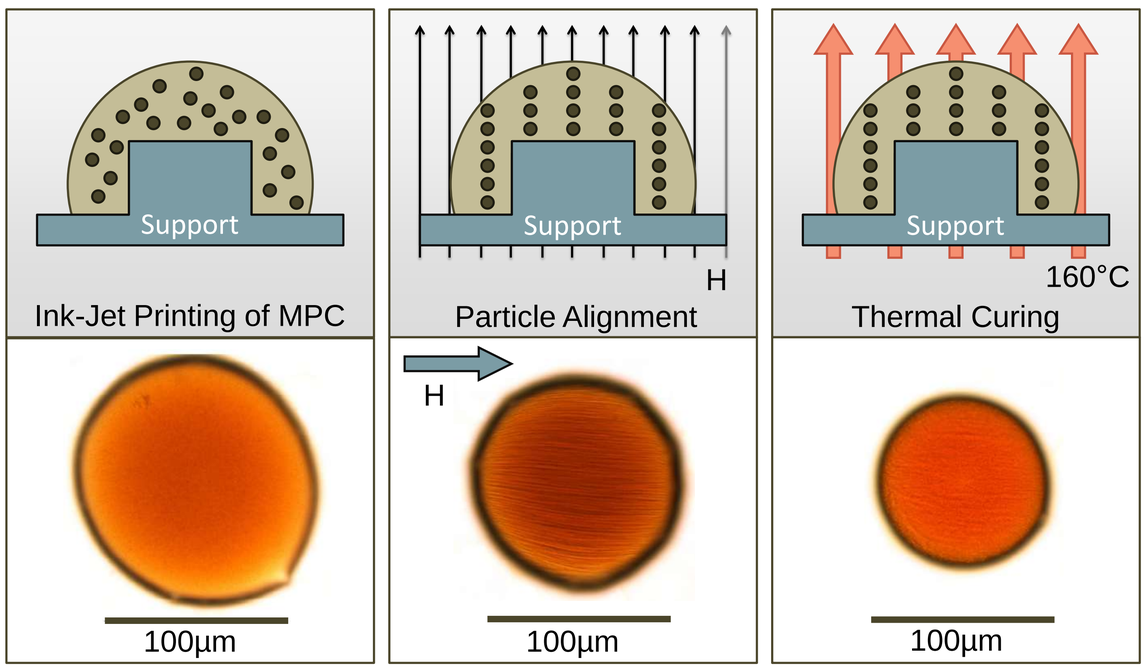




Magnetic Anisotropy

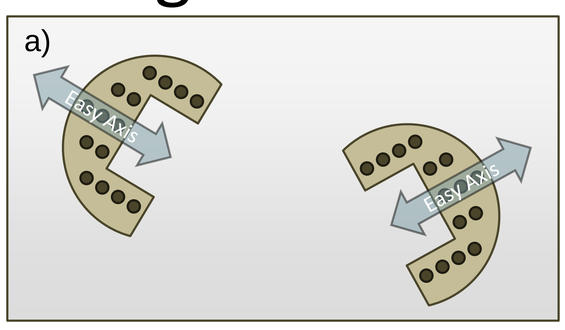
- Refers to orientation-dependent magnetic properties
- Implies so-called easy axis along which soft magnetic objects align when subjected to an external field
- For polymer composites (developed within SelfSys framework, [2]), anisotropy is solely related to shape

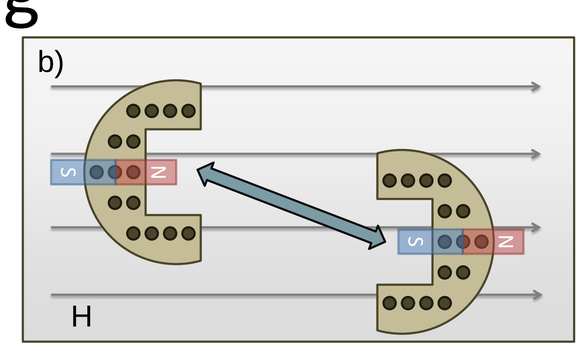
Decoupling Shape & Anisotropy

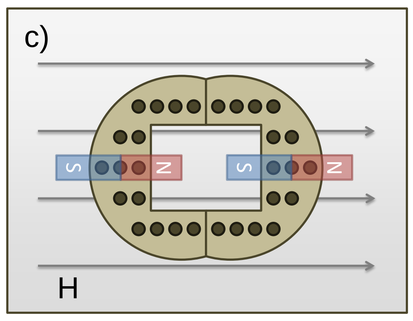


- Super-paramagnetic nanoparticles embedded in uncured polymer matrix aligned by external H fields
- Ink-jet printing & thermal curing allow for deposition of features beyond exposable resist thickness [2]

Magnetic Guiding

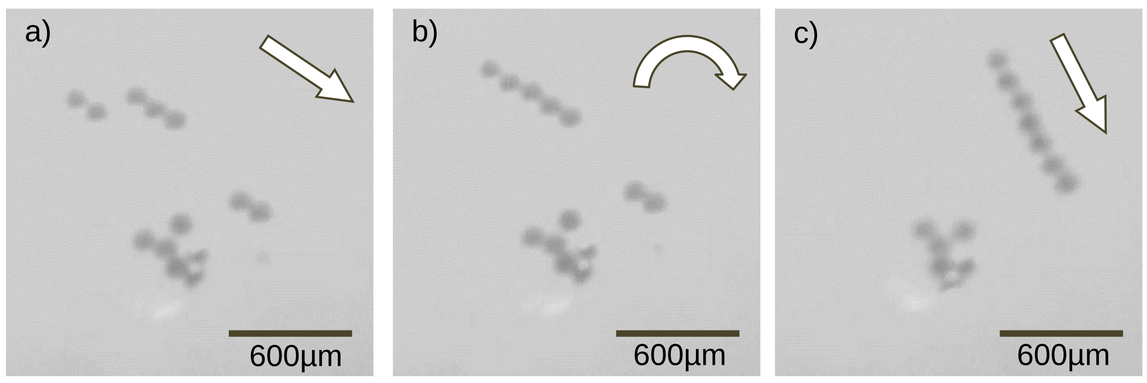






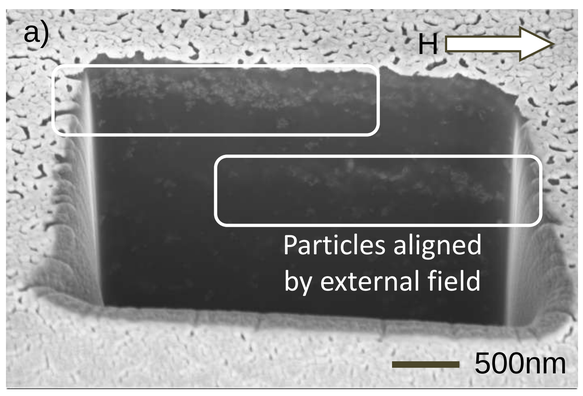
a) Building blocks with aligned easy axis after release
b) Blocks align with external field, field induces magnetic moment
c) Building blocks attract each other and align

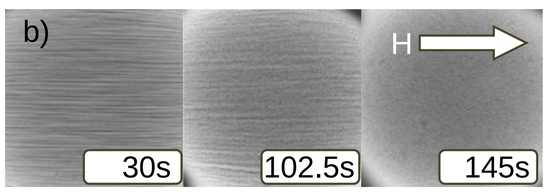
Experimental



Manipulation of ink-jet printed half-capsules, arrows indicate direction/rotation of the applied field, which leads to next consecutive picture

Characterization





a) FIB & subsequent SEM
b) Result of delay between printing and alignment for different samples

Conclusion & Outlook

A combination of ink-jet printing, particle alignment and thermal curing allows for magnetically guided self-assembly. Improved results are expected when all three fabrication steps are carried out in parallel.

This work has been carried out in the framework of SelfSys, scientifically evaluated by SNSF as well as financed by the Swiss Confederation and funded by Nano-Tera.ch.

[1] **"In-liquid pairwise self-assembly of SU-8 based building block"** L. Jacot-Descombes, M.R. Gullo, V.J. Cadarso, M. Mastrangeli, J. Brugger (Nano-Tera.ch annual plenary meeting, 2012)

[2] ***A photopatternable superparamagnetic nanocomposite: Material characterization and fabrication of microstructures*** M. Suter, O.Ergeneman, J.Zürcher, C.Moitzi, S.Pané, T.Rudin, S.E. Pratsinis , B.J.Nelson, C.Hierold, *Sens. Actuators B: Chem.,* (2011)

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