

## High Temperature Magnetic Measurements to Investigate Semiconducting/Ferromagnetic Nanocomposites

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Porous silicon (PSi) and silicon nanotubes (SiNTs) are presented as a platform for filling with FePt nanostructures. The difference of the magnetic characteristics between the two systems is figured out. Furthermore, the FePt filled templates are compared with the same template materials filled with Ni/Co by electrodeposition.

The porous silicon is produced by anodization of a highly doped n-type silicon wafer in a 10 wt% HF solution. The produced morphology offers separated pores of about 50 nm and a mean distance between the pores of 50 nm. The SiNTs are fabricated in using an array of ZO wires as template, subsequent silicon deposition and finally etching off the ZO. The inner diameter of the tubes and also the wall thickness can be tuned by the fabrication process. In this work SiNTs with comparable inner diameter to the PSi structure and a wall of about 10 nm are used [1]. FePt nanoparticles (NPs) are deposited electroless inside the pores and the tubes, respectively whereat the molar ratio of Fe is varied. For this purpose a 3 component solution consisting of  $\text{H}_2\text{PtCl}_6$ ,  $\text{Fe}(\text{NO}_3)_3$  and citric acid is used, whereas the ratio of the components is modified.

Ni and Co, both metals are electrodeposited within the nanostructured silicon in using aqueous  $\text{NiSO}_4$  and  $\text{CoSO}_4$  solutions by applying a current density of  $15 \text{ mA/cm}^2$  and a frequency of 0.1 Hz.

The varying magnetic response of the different composite systems, porous silicon and silicon nanotubes is investigated. PSi/FePt shows a higher coercivity and remanence than SiNTs/FePt and thus a higher hard magnetic performance. The variation of the coercivities between SiNTs/FePt and PSi/FePt is about 57%.

Considering the FePt deposits with different molar ratio of Fe the coercivities vary in a range of 5% in the case of both template types. Comparing FePt loaded samples with Co loaded samples in all cases an increase of the coercivity and of the remanence is observed for FePt, whereat in the case of PSi as template material the increase is significantly stronger than in the case of SiNTs samples. Figure 1 shows the comparison of the hysteresis of PSi and SiNTs filled with FePt NPs.

Beside low temperature and room temperature magnetic measurements, the magnetic behavior of the samples is investigated at high temperatures up to 1273 K.

### References

- [1] K. Rumpf, et.al, ECS Transactions 98 (2020) 37

### Figures

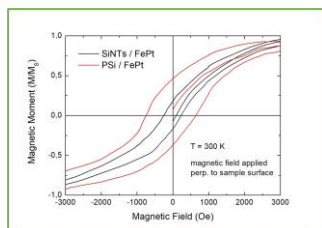


Figure 2: Hysteresis curves of PSi (red line) and SiNTs filled with FePt NPs.