**IN-FLIGHT OPTICAL ANNEALING OF FePt NANOPARTICLES.**

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Monodisperse fractions of FePt nanoparticles within a size range of 4-6 nm were prepared by DC magnetron sputtering in an inert gas atmosphere at elevated gas pressures of roughly 1 mbar. Subsequent ejection into high vacuum results in an increase of the mean free path of the particles and thereby in a substantial suppression of particle-particle coagulation, hence the formation of particle agglomerates can be effectively controlled. In order to prepare the chemically ordered tetragonal $L1_0$ phase without sacrificing monodispersity, the particles were subjected to in-flight thermal annealing prior to their deposition. This ordered phase is of particular interest owing to its very high magneto-crystalline anisotropy.

Since convective heating [1] is not an option in high vacuum, optical heating is necessary in order to thermally treat the particles in-flight. We have therefore developed an ultra high vacuum (UHV) compatible light furnace, in which three halogen lamps (with a total power of up to 4.5 kW) are focussed on the flight path of the particles at a length of 150 mm. The morphology and crystal structure of the deposited particles are characterized by (high resolution) transmission electron microscopy ((HR)TEM).

Inter-particle coalescence (sintering) as induced by the in-flight optical annealing was studied as function of the applied power of the light furnace. TEM investigations show that it is possible to sinter particle agglomerates down to single particles when a sufficiently high power is provided to the optical furnace. The minimum temperature of the particles during the in-flight annealing was estimated to be T = 800°C, which implies that the construction of the light furnace allows for an effective radiative heat transfer to the particles. The experimental results were corroborated by model calculations of the energy transfer based on classical electrodynamics. Investigations of particles, which were deposited at a certain distance to the principle particle flight path and thus to the focus line of the light furnace, show that particles, which do not travel completely within this focal line, experience a reduced degree of inter-particle coalescence.

(HR)TEM investigations provide evidence for the formation of the ordered $L1_0$ phase in the in-flight annealed particles, if the annealing temperature is at least T = 800°C. It is noteworthy that the $L1_0$ ordering was achieved even though the annealing times were as short as roughly one millisecond. The experimental results will be analysed with respect to the $L1_0$ ordering kinetics, and the magnetic properties of the deposited particles will be discussed.

**References:**

[1] S. Stappert et al., J. Cryst. Growth 252 (2003) 440-450.

**Figures:**

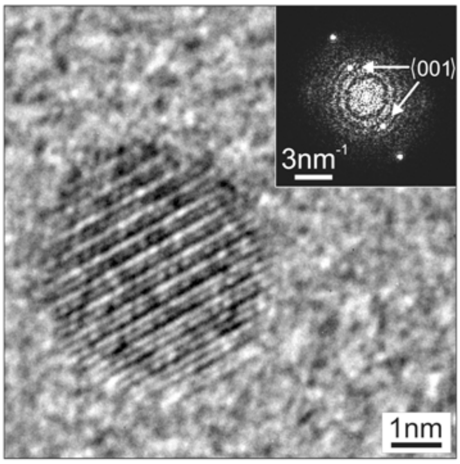


**Fig. 1** HRTEM micrograph of a $L1_0$ ordered FePt nanoparticle, as obtained after in-flight optical heating. The Fourier transform of the image (insert) clearly reveals the occurrence of (001) super structure reflections.