# MM 4 Phase transitions I

Time: Monday 10:15–11:15 Room: IFW D

MM 4.1 Mon 10:15 IFW D

**AFM, TEM and SEM studies of nano-scale plate-like precipitates** — •Dietmar Baither[1], Ihor Sobchenko[1], Josef Pesicka[1], Thomas Pretorius[1], Volker Mohles[2], Werner Stracke[3], Rudolf Reichelt[3], and Eckhard Nembach[1] — [1]Institut fuer Materialphysik, Universitaet Muenster — [2]Institut fuer Metallkunde und Metallphysik, RWTH Aachen — [3]Institut fuer Medizinische Physik und Biophysik, Universitaet Muenster

The high strength of many structural materials derives from coherent nano-scale precipitates of secondary phases, for example Guinier-Preston zones in aluminium based alloys or $\gamma'$ precipitates in nickel based superalloys. Their shape, size and volume fraction crucially determine the strengthening effect. An alloy with the composition $Ni_{69}Co_9Al_{18}Ti_4$ was used as model system to determine these parameters for nano-scale plate-like precipitates. Such precipitates of the disordered $\gamma$ phase arise in the $L1_2$-long-range ordered $\gamma'$ phase of the matrix after 333 h annealing treatment at 1173 K. From TEM micrographs an approximate mean edge length of 400 nm and a thickness of 40 nm of the precipitates were determined. A precise description of their shape was derived using superellipses. The main task was to attain comparable results by AFM. These investigations revealed that the electrolytic etching of the surface attacks preferentially the plate-like precipitates so that deep dimples are formed. Problems and limitations of the AFM characterization of this morphology will be discussed.

MM 4.2 Mon 10:30 IFW D

**Coarsening dynamics in elastically anisotropic alloys** — •Bastian Pfau[1], Lorenz-Mathias Stadler[1], Bogdan Sepiol[1], Richard Weinkamer[2], Federico Zontone[3], and Gero Vogl[1] — [1]Fakultät für Physik der Universität Wien, Strudlhofgasse 4, A-1090 Wien, Austria — [2]Max-Planck-Institut für Kolloid- und Grenzflächenforschung, D-14424 Potsdam, Germany — [3]European Synchrotron Radiation Facility, BP 220, F-38043 Grenoble Cedex, France

With the availability of coherent X-rays at third-generation synchrotrons it became possible to investigate the very slow dynamics of precipitate coarsening in phase separating alloys by utilising the emerging method of X-ray photon correlation spectroscopy [1]. Here, we present an in-situ study of coarsening dynamics in elastically anisotropic alloys [2]. Fluctuating speckle intensities in time series of coherent small-angle X-ray diffraction images are analysed for two different Ni–Al–Mo samples with different lattice misfit between precipitates and matrix. The detected long-term correlations depend not only on the norm but strongly on the direction of the scattering vector. The experimental findings are compared with results from Monte Carlo simulations. Our experiments together with the simulations indicate that in alloys with high elastic misfit, precipitate coarsening proceeds almost exclusively within {100} planes. Furthermore, our data suggest that plate-like precipitates are formed by coalescence of smaller particles.

[1] L.-M. Stadler et al., Phys. Rev. B **68**, 180101(R), (2003).
[2] B. Pfau et al., Europhys. Lett., to be submitted.

MM 4.3 Mon 10:45 IFW D

**Monte Carlo Simulation of Phase Separation Including Elastic Relaxations** — •Rolf Anders and Ferdinand Haider — Univ. Augsburg, Institut f. Physik

We developped a real space technique which includes local atomic relaxation during each atomic jump, allowing thus to study phase transformations with strong elastic contributions. For each atomic jump, the activation energy is computed using phenomenological interaction potentials. After a succesful jump the atomic coordinates in the vicinity of the jumping atom are relaxed in order to minimise the total energy.

Using this method we studied different binary Lennard-Jones alloys. At suitable potential parameters oriented precipitates were forming due to the elastic anisotropy of the material. We also observed an asymmetric microstructure with respect to components if the atom sizes are different. This is caused by the different elastic properties, which are directly related to the atom size in the LJ potential.

MM 4.4 Mon 11:00 IFW D

**Time dependent phenomena in the athermal martensite $Ni_{63}Al_{37}$** — •Benno Ludwig, Leonard Müller, and Uwe Klemradt — II. Physikalisches Institut, RWTH Aachen University

The unexpected finding of time-dependent behaviour in athermal martensitic transformations above the $M_S$ temperature [1] has prompted further experimental studies of so called incubation time (waiting time). Several theoretical models have been put forward, which, however, disagree with each other on the detailed transformation mechanism [1,2].

In order to contribute to the ongoing discussion measurements employing different in-situ methods combined with a excellent temperature stability of $\pm 4$ mK over several days were conducted. Results clearly show the existence of incubation times between 50 s up to 112000 s despite the fact that the $M_S$ temperature is not a constant but rather a fluctuating variable on a superimposed trend. In addition the obtained data suggests a strong dependence on the thermal history of the sample. The results will be discussed in view of the competing theoretical notions.

[1] Mat. Sci. Eng. **A273-275** 21-39 (1999) and ref. within
[2] Scripta Mat. **50** 181-186 (2004), Scripta Mat. **45** 145-152 (2001)