MM 20 Intermetallische Phasen I

Zeit: Samstag 09:15–10:30 Raum: TU H2038

MM 20.1 Sa 09:15 TU H2038

Mechanical Spectroscopy of Fe-Al alloys with Al concentrations up to 26 at.%. — •A. Strahl[1], S.B. Golovina[2], I.S. Golovin[2], and H. Neuhäuser[1] — [1]TU-BS, Institut für Metallphysik u. Nukleare Festkörperphysik, D-38106 Braunschweig — [2]TU-BS, Institut für Werkstoffe, D-38106 Braunschweig

Temperature and time dependent internal friction (mechanical spectroscopy) of quenched Fe-Al-C alloys has been measured monitoring the Snoek-type relaxation (jumps of interstitial carbon atoms) in dependence of Al concentration. With an increase of Al substitutes in iron, the Snoek type peak changes its shape in a few steps. In the range 3-8 at.% Al in iron the peak is clearly composed of two Debye-type peaks: the peak at lower temperature corresponds to the original Snoek peak; the peak at higher temperature is caused by jumps of carbon atoms on places with nearby Al atoms. Above a critical Al concentration the original Snoek peak practically vanishes: in that case the surrounding of a C-atom is changed from Fe atoms to a random or ordered mixture of Fe and Al atoms, increasing the carbon hopping potential, shifting the Snoek-type relaxation to higher temperatures, and increasing the peak widths; such a peak is recorded in intermetallic compounds Fe_3Al.

By isothermal annealing experiments at selected temperatures around the observed peaks the long-term kinetics of carbon jumps has been followed in some detail to evaluate parameters of the process of carbon atoms removal from the interstitial solid solution. The observation of two relaxation rates associated with the decrease of Snoek-type peaks in Fe-Al-C alloys corresponds to nucleation and growth of carbides.

MM 20.2 Sa 09:30 TU H2038

Mechanical spectroscopy of high pressure torsion (HPT) deformed Fe_3Al based alloys — •T.S. Pavlova[1,2], I.S. Golovin[2], H.-R. Sinning[2], and R.Z. Valiev[3] — [1]Physics of Metals Department of Tula State University, Lenin ave. 90, Tula, Russia — [2]TU Braunschweig, Institut fuer Werkstoffe, Langer Kamp 8, D-38106 Braunschweig — [3]Institute of Physics of Advanced Materials, Ufa State Aviation Technical University, Russia

The method of mechanical spectroscopy (especially internal friction measurements) is known as an effective tool for studying dislocation behaviour in deformed metals. However, for brittle intermetallic compounds like Fe_3Al, a problem is that deformation at room temperature is hardly possible by ordinary methods but requires special techniques like, for instance, high pressure torsion (HPT).

Several internal friction peaks were distinguished in HPT Fe_3Al-based alloys. Most of them are analogous to those found in deformed and irradiated pure iron, where they are known to be caused by dislocations. In HPT Fe-Al specimens, these peaks are significantly reduced already by moderate heat treatments, including even the unavoidable tempering during the measurements themselves. It is notable that using these internal friction peaks, earlier stages of annealing processes in HTP materials can be detected than by other methods, which show annealing effects only at higher temperatures. Preliminary interpretations of these peaks will be presented.

MM 20.3 Sa 09:45 TU H2038

Einfluss der Wärmebehandlung auf die Fernordnung und die magnetischen Eigenschaften von dünnen Filmen aus FePd — •Chaisak Issro[1], Wolfgang Püschl[1], Wolfgang Pfeiler[1], Peter F. Rogl[2], William A. Soffa[3], Rafal Kozubski[4] und Veronique Pierron-Bohnes[5] — [1]Inst. f. Materialphysik, Universität Wien — [2]Inst. f. Phys. Chemie, Universität Wien — [3]Dept. of Mat. Sci. & Eng., Univ. of Pittsburgh — [4]M. Smoluchowski Inst. of Physics, Jagellonian Univ. Cracow — [5]Inst. Phys. & Chim. Materiaux de Strasbourg

Dünne Filme aus FePd wurden auf Si gesputtert und auf MgO epitaktisch aufgebracht. Zum Vergleich wurde die Ordnungseinstellung einer anfangs ungeordneten, kaltgewalzten Folie während einer isochronen Wärmebehandlung mit Röntgenbeugung, Restwiderstandsmessungen und ihrem magnetischen Verhalten verfolgt. Der auf Si-Substrat aufgesputterte Film ist zuerst völlig ungeordnet. Bei der anschließenden Auslagerung ordnet der Film in $L1_0$-Struktur, wobei alle Varianten geordneter Domänen entstehen (Magnetisierungskurven). Die epitaktischen Filme sind sofort hoch geordnet, nahezu einkristallin (c-Achse normal zur Filmoberfläche) und magnetisch anisotrop. Ab 500 K beginnen sich die geordneten Domänen mit ihrer c-Achse in die Filmebene zu drehen. Dieser überraschende Effekt stimmt mit jüngsten MC-Simulationen der Ordnungskinetik in sehr dünnen FePt Schichten (10 Atomlagen) überein.

MM 20.4 Sa 10:00 TU H2038

Long-periodic superlattices in Cu-rich Cu-Pd alloys - an ab-initio study — •S. Bärthlein[1], G.L.W. Hart[2], A. Zunger[3], and S. Müller[1] — [1]Festkörperphysik, Universität Erlangen-Nürnberg, Staudtstr. 7, D-91058 Erlangen — [2]Department of Physics and Astronomy, Northern Arizona University, Flagstaff, Arizona 86011-6010 — [3]National Renewable Energy Laboratory, Golden, Colorado 80401

Beside the well-known L12-phase, Cu-rich Cu-Pd alloys form one- and two-dimensional long-periodic superlattices (LPS). Combining total-energy DFT calculations, a mixed-space cluster-expansion (CE) and genetic algorithms [1], we construct effective multibody interactions, allowing for a detailed study of the structure and stability of these LPS-phases. In good agreement with experiment, at 25% Pd a subtle hierarchy of LPS-structures is found with the so-called LPS3-structure as T=0K ground state, *not* just being an entropically stabilized feature. With the help of Monte-Carlo simulations, phase transition temperatures and short-range order behaviour (SRO) are predicted. Hereby, the SRO-pattern of the LPS-phase shows a four-fold peak-splitting at $\langle 110 \rangle$ and a two-fold one at $\langle 100 \rangle$, allowing for a determination of the Fermi-vector. The results are in excellent agreement with experimental data. (Supported by DFG.)

[1] G.L.W. Hart et al., submitted (2004)

MM 20.5 Sa 10:15 TU H2038

Characterization of Cu/Sn and Cu/SnPb solder reaction — •Jens Görlich and Guido Schmitz — Institut für Materialphysik, Wilhelm-Klemm-Straße 10, 48149 Münster

Development of leadfree solders and a further size reduction in electronic devices require a better understanding of physical mechanisms during soldering. Diffusion paths, kinetic processes and - especially for microdevices - the unfavorable fast growth of the non planar intermetallic Cu_6Sn_5 layer during the interreaction between solid Cu and liquid tin-lead or pure liquid tin solder have been investigated. SEM analyses revealed a time dependence of the scallop-like Cu_6Sn_5 intermetllic layer of $R \sim t^{1/3}$. The interfaces between Cu and the solder were analysed by HREM and EELS and the wetting angles for pure tin and tin-lead solder were determined. The growth of the scallop like structure is controlled by grain boundary diffusion across the existing Cu_6Sn_5 layer. Nevertheless, the observed process may be still described by a recent model [1], which assumes the transport through channel of liquid solder. Furthermore, the influence of a sputter-deposited Cu_6Sn_5 base metallization was investigated. The results will be discussed in view of the technologically desired limitation of the fast growth of Cu_6Sn_5.

[1] A.M. Gusak, Phys. Rev. B 66, 115403 (2002)