MM 26: Liquid and Amorphous Metals I

Time: Wednesday 14:00–15:15 Location: H 0107

MM 26.1 Wed 14:00 H 0107

Diffusion of Nickel atoms in liquid Silicon — •Anja Ines Pommrich[1], Andreas Meyer[1], Dirk Holland-Moritz[1], and Tobias Unruh[2] — [1]Institut für Materialphysik im Weltraum, DLR, Köln — [2]Forschungsneutronenquelle Heinz Maier-Leibnitz (FRMII), Garching

For the production of Silicon wafers for solar cell applications the knowledge of impurity diffusion of metal atoms in liquid Silicon is necessary to describe the directional solidification process. We measured the Nickel diffusion in liquid Silicon by quasielastic neutron scattering on the TOFTOF-spectrometer of the FRMII in Munich. Electromagnetic levitation was used for container-less processing. This allows diffusion measurements not only in the equilibrium melt but also in the undercooled melt with temperatures up to 280 K below the melting point.

First results show a fast Nickel diffusion as compared to other alloy systems. Furthermore the Nickel self-diffusion coefficients exhibit within error bars no concentration dependence in the range of 5 at% to 20 at% of Nickel and an Arrhenius type temperature dependence.

MM 26.2 Wed 14:15 H 0107

Viskositätsmessungen an flüssigen ternären Cu-Ni-Co Legierungen — •Michael Schick und Ivan Egry — Deutsches Zentrum für Luft- und Raumfahrt, Institut für Materialphysik im Weltraum, 51170 Köln

Für flüssige ternäre Cu-Ni-Co Legierungen wurden mit einem Hochtemperaturviskosimeter [1] die temperaturabhängigen Viskositäten für verschiedene Zusammensetzungen gemessen. Grundlage des Messverfahrens ist die Schwingtiegelmethode [2]. Hierbei wird die in einem Tiegel befindliche Metallschmelze zu einer gedämpften Drehschwingung angeregt. Aus der Dämpfung der Amplitude und der Periodendauer der Schwingung lässt sich mit der Gleichung von Roscoe [2] die Viskosität der Schmelze berechnen. Aus der Temperaturabhängigkeit der Viskositäten können mit Hilfe eines Arrhenius-Ansatzes die Aktivierungsenergien des viskosen Flusses in Abhängigkeit von der Zusammensetzung bestimmt werden. Ein Vergleich der aus den Messungen bestimmten Aktivierungsenergien mit denen, die durch Linearkombination aus den Aktivierungsenergien der reinen Elemente Cu, Ni und Co berechnet wurden, erlaubt Rückschlüsse auf das Mischungsverhalten der Legierungen.

[1] M. Kehr, W. Hoyer, I. Egry: Int. J. Thermophys. 28 (2007) 1017
[2] R. Roscoe: Proc. Phys. Soc. 72 (1958) 576

MM 26.3 Wed 14:30 H 0107

Diffusion of ^{32}P, ^{57}Co and ^{103}Pd in the glass-forming $Pd_{43}Cu_{27}Ni_{10}P_{20}$ alloy and its relation to viscosity — •Alexander Bartsch[1], Klaus Rätzke[1], Andreas Meyer[2], and Franz Faupel[1] — [1]Technische Fakultät, Univ. Kiel, Kaiserstr.2, 24143 Kiel — [2]Institut für Materialphysik im Weltraum, DLR Köln

Since the development of bulk metallic glasses there has been considerable research effort on these alloys. Due to the high stability against crystallisation the undercooled melt between melting temperature and caloric glass transition temperature is now accessible so that recent theories can be tested.

In general, the Stokes-Einstein equation is well accepted in the equilibrium melt of these alloys. In the supercooled melt a decoupling of diffusivity and viscosity around the critical temperature of the mode coupling theory is observed [1]. Now the ^{32}P, ^{57}Co and ^{103}Pd diffusion were measured in a temperature range from 573 K up to 800 K in the $Pd_{43}Cu_{27}Ni_{10}P_{20}$ alloy using the radiotracer technique. We found that P and Co have similar diffusivities and compared them to viscosity data using SE equation [2]. This shows that the mobility of P and Co do not determine the viscosity in the supercooled state. Based on ongoing experiments with ^{103}Pd we now can give an overview on the relation between diffusion and viscosity of all constituents of the alloy.

[1] V. Zöllmer, K. Rätzke, F. Faupel, A. Meyer, Phys. Rev. Lett., 90, 195502-1 (2003).
[2] A. Bartsch, K. Rätzke, F. Faupel, A.Meyer, Appl. Phys. Lett. 89, 121917 (2006)

MM 26.4 Wed 14:45 H 0107

Effect of composition on crystallization behavior and viscosity of Zr-based metallic glasses — •Sergio Scudino, Birgit Bartusch, and Jürgen Eckert — IFW Dresden, Institut für Komplexe Materialien, Postfach 27 01 16, D-01171 Dresden, Germany

The variation of Al and Zr drastically affects the crystallization behavior and the viscosity of the melt-spun Zr-Ti-Nb-Cu-Ni-Al glassy ribbons. The devitrification of the ribbons with high Zr or low Al contents is characterized by the formation of a metastable quasicrystalline phase during the first stage of the crystallization process. With increasing Al or decreasing Zr contents the temperature range of stability of the quasicrystals decreases and their formation is progressively hindered. The temperature of the glass transition and the crystallization temperatures related to the crystallization events shift to higher values with increasing Al or decreasing Zr contents. At the same time, the viscosity of the supercooled liquid and the fragility parameter (D) increase, indicating an improved glass forming ability. A clear correlation between fragility parameter and glass transition has been found. This correlation provides a guide for the estimation of D for this particular system when the glass transition is known.

MM 26.5 Wed 15:00 H 0107

FeNbB bulk metallic glass: the influence of fluxing technique — •Mihai Stoica[1], Santosh Kumar[1,2], Stefan Roth[3], Shanker Ram[2], Jürgen Eckert[1], and Alain Reza Yavari[4] — [1]IFW Dresden, Institute for Complex Materials, P.O. Box 270116, D-01171 Dresden, Germany — [2]Materials Science Centre, Indian Institute of Technology, Kharagpur 721302, India — [3]IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany — [4]LTPCM-CNRS, Institut National Politechnique de Grenoble, 1130 Rue de la Piscine, BP 75, Saint Martin dHères Campus 38402, France

Recently, a new Fe-based BMG containing only 3 elements and a very high boron ($Fe_{66}Nb_4B_{30}$) content was synthesized. The preparation of this BMG was done by employing the copper mould casting method and using the fluxing technique. This new BMG is ferromagnetic, with a Curie temperature around 550 K and a saturation magnetization of 105 emu/g. Differential scanning calorimetry (DSC) investigations revealed a reduced glass transition temperature of 0.58 and an extension of the supercooled liquid region of about 31 K, values which indicate a relatively good thermal stability. Fluxed and not-fluxed master alloys were used to cast samples. The present work aims to discuss, for both kinds of samples, the kinetics of the phase formation using the Kissinger analysis and Johnson-Mehl-Avrami plots, correlated with the results obtained from X-ray diffraction (XRD) of samples with different metastable structures. Additionally, the magnetic behaviour of different phase(s) will be discussed.