DSC and XRD investigation on melt-spun $DyMn_{6-x}Ge_{6-x}Fe_xAl_x$ (x = 1, 1.5, 2)

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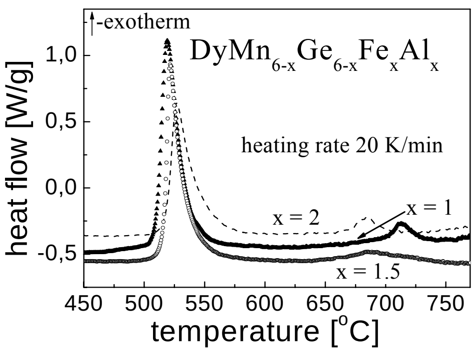
In the last years a great interest in bulk amorphous metallic alloys can be recognised. These materials may have outstanding properties like excellent elastic behaviour combined with high hardness. Their glass forming ability (GFA) is of particular importance for understanding of these metastable multicomponent alloys. The GFA is the main factor, which provides the possibility to produce new engineering materials with remarkable properties. Bulk amorphous magnetic alloys have received less attention, but they may provide interesting properties from an interplay of particular magnetic and mechanical properties. Here we report results on a series of multicomponent $DyMn_{6-x}Ge_{6-x}Fe_xAl_x$ (x = 1, 1.5, 2) alloys, which is derived from a ternary system combining transition metals (TM) Fe and Mn, rare-earths (R), and (M) Ge and Al (metalloid or simple metal). The chosen compositions form a pseudo-binary series of alloys between well-known intermetallic compounds with particular magnetic properties, *i.e.* helimagnetic $DyMn_6Ge_6$ and ferrimagnetic $DyFe_6Al_6$. Ribbons from this alloy series were prepared by arc-melting and subsequent melt spinning. Cooling rates were always similar and relatively low, controlled by the chosen wheel surface velocity of 25 m/s. For some compositions thick amorphous ribbons (d = 50 - 70 μm) are obtained. The amorphous structure of the samples was checked by X-ray diffraction (XRD), both for free and wheel side. These measurements show that the amorphous state can be stabilised in samples with unusually great thickness. Temperatures of crystallisation and enthalpies have been determined by differential scanning calorimetry (DSC) measurements. Crystallisation temperatures are higher with growing *x*, *i.e.* by replacing Mn and Ge with Fe and Al, respectively.

For example the onset crystallisation temperature obtained from DSC measurement with 20 K/min heating rate for $DyMn_5Ge_5FeAl$ is $T_x \approx 510°C$. It increases to $T_x \approx 518°C$ for $DyMn_4Ge_4Fe_2Al_2$ (see Fig.). A second crystallisation peak at higher temperature shifts to lower temperatures with growing *x*. Therefore, the temperature stability of the first occurring phase in these ribbons is decreasing with increasing Fe and Al content. The two-step crystallisation behaviour suggests that the metastable amorphous state in this composition range is stabilised because the stable state must be composed of a mixture of different crystalline phases that cannot be nucleated easily in multicomponent compounds. Magnetic and magnetotransport properties of these alloys are currently investigated.



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