Structure and hyperfine fields of $DyMn_{6-x}Fe_xGe_6$ ($0 \leq x \leq 6$) alloys

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The multicomponent $DyMn_{6-x}Fe_xGe_6$ ($0 \leq x \leq 6$) alloy series, which is derived from a ternary system combining transition metals (TM) Fe and Mn, rare-earths element (R) Dy, and metalloid (M) Ge, belongs to a group of magnetic compounds with complex magnetic ordering. The chosen compositions form a pseudo-binary series of alloys between $DyFe_6Ge_6$ and $DyMn_6Ge_6$. Those two compounds crystallize with orthorhombic $TbFe_6Sn_6$-type structure (space group *Cmcm*) and hexagonal $HfFe_6Ge_6$-type structure (*P6/mmm*), respectively, and both behave as antiferromagnet. The R- and TM- magnetic sublattices in $DyMn_6Ge_6$ order simultaneously. This compound shows magnetic ordering with a transition in the range 80 – 100 K from a triple flat spiral to a triple conical spiral below this temperature [1, 2].

Here, we report results concerning the role of Mn substitution by Fe on both the structural and magnetic properties in these alloys. Ribbons from this alloy series were prepared by arc-melting and subsequent melt spinning. The structure of the samples was studied by X-ray diffraction (XRD). In melt-spun state $DyFe_6Ge_6$ and $DyMn_6Ge_6$ have different structures than stabilized ones. Both possess metastable hexagonal $TbCu_7$-type structure (*P6/mmm* space group). The alloyed samples have the same crystalline structures, except $DyMn_{5.5}Fe_{0.5}Ge_6$, which is fully amorphous. The origin of such behaviour was already described for $DyMn_{6-x}Ge_{6-x}Fe_xAl_x$ ($0 \leq x \leq 6$) [3]. ^{57}Fe Mössbauer spectroscopy at different temperatures was used to investigate the local magnetic ordering in $DyMn_{6-x}Fe_xGe_6$ series, in particular the atomic substitution effect. A progressive change from a magnetic to a quadrupolar hyperfine structure is observed. This trend is discussed in terms of the structural features of the alloyed samples and can be correlated with results of static magnetic measurements.

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