Article ID: 1003−7837(2005)02,03−0223−01

The structural transformation in doped TiNi: dissolution of solid solutions and martensite transformations

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The analysis of experiments demonstrates that in TiNi with dope d-transition elements of V−VIII subgroups the type of solid solution is determined not by the specific dope element, but by pertaining of the alloy to one of three main sections of state diagram for the system Ti-Ni-Me. (Me is the dope metal) corresponding to the formulas $Ti_{50}Ni_{50-x}Me_x$, $Ti_{50-x}Ni_{50}Me_x$, $Ti_{50-x}Ni_{50-x}Me_{2x}$. Existing experimental data allows asserting the presence at least two types of dissolution of B2-solid solution in the alloys on the basis of TiNi, each type is accompanied by the regular changes in the characteristics of martensite transformations.

The dissolution of metastable hardened B2-solid solutions (α-phase) in the alloys of type $Ti_{50-x}Ni_{50}Me_x$ takes place according to the following scheme $\beta_{met} \rightarrow \beta_{eq} + Ni_4Ti_3$. The dissolution of metastable solid solution β_{met} is accompanied by its depletion of nickel with the result that the start temperature of martensitetransformations M_H and T_R into martensites B19′ and R moves monotonically up on the temperature scale. At this the diapason of martensite points displacement for some alloys reachs the values of ~ 300 K. This type of dissolution takes place practically for all studied alloys of this section: $Ni_{50}Ti_{46}Mo_4$, $Ni_{50}Ti_{46}Nb_4$, $Ni_{50}Ti_{46}V_4$, $Ni_{50}Ti_{46}Ta_4$, $Ni_{50}Ti_{46}Mn_4$, $Ni_{50}Ti_{46}Re_4$.

Another type of dissolution takes place for the alloys pertaining to two other types of triple state diagram $Ti_{50-x}Ni_{50-x}Me_{2x}$ and $Ti_{50-x}Ni_{50}Me_x$ Namely, in the $Ni_{48}Ti_{48}V_4$, $Ni_{46}Ti_{46}V_8$, $Ti_{50}Ni_{46}V_4$ at early dissolution stages one observes the stratification of B2-solid solution to two isomorphic phases B2(1) and B2(2). The phases B2(1) and B2(2) differ either in the elements concentrations or in the type of order and endure the martensite transformations with specific features that are caused by the non-unifirmity of initial austenite phase. These features include, first of all, complex sequence of martensite transformations under cooling and anomalous temperature hysteresis of transformation B2→R under thermocycling. It is worth to mention that the phenomenon of complex sequence of martensite transformations under cooling can be explained in the frame of additive model as the superposition of two sequences in solid solutions B2(1) and B2(2) while anomalous temperature hysteresis can not be explained in the frame of the same model.

Received date: 2005−08−29