Nanocomposites and nanomaterials

The influence of the nanostructure state on the formation of high entropy alloy properties

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High entropy alloys (HEAs) are relatively new type of the metallic alloys. HEAs contains 5 and more component in almost equiatomic content. HEAs are characterized by the solid solution structure from simple cubic (BCC or FCC) cell. High entropy contribution to Gibbs energy and high quantity components, as expected, are main reasons of set unique properties of such alloys that can not be revealing by the traditional metallic alloys.

In the current work, on the example of FeCoNiCrMn HEA, it has been shown the structure of HEAs must be considered as the structure of the solid solution from nanostructured fragments and/or nanosized formation.

Such, the temperature dependencies of the magnetic susceptibility (Faradays methods, T=300-900 K) are described by the Curie-Weiss dependence, however, the effective moment values (3-6μ_B, depends on prehistory) exceed the maximal value, which can be obtained from constituent metals. Such high experimental values can be result in formation super paramagnetic clusters from strong exchange interaction inside.

The electrical properties (four-point method, T=77-900K) reveal unusual dependencies on the deformation. Such behavior has typical character of K-state that has been detected in some transition metal based alloys. The source such state has been connected to nanosized creation from the peculiar ordering.

Though the results of electromicroscopic studies often shown on the formation of the significant size crystallite in HEAs (even micrometers) the results of the X-ray maxima profile analyze (DRON-4, Coα-radiation, harmonic analysis or approximation method) reveal the coherent scattering units of the 5-40 nm. In additional the low angle scattering on rolling simples (low angle X-ray diffractometer based on AMUR-1 goniometer with slot collimation system) give evidence on existence of 15-20 nm heterogeneities.

So, the received experimental results denote, the HEAs properties are determined not only the compositional peculiarities. The nanosized elements have the essential influence on theirs. Such features would explain the set of the differences between experimental results.