

The Melting and Solidification Loops of Cu-Ni Nanoparticle

Shirinyan A.S.¹, Wilde G.², Makara V.A.^{1,3}, Bilogorodskyy Y.S.⁴,
Komisarenko O.S.³

¹ *“Physical-chemical materials science” center of National Academy of Sciences of Ukraine
and Kiev Taras Shevchenko National University, Kyiv, Ukraine*

² *Institut für Materialphysik, Westfälische Wilhelms-Universität Münster,
Münster, Germany*

³ *Kiev Taras Shevchenko National University, Kyiv, Ukraine*

⁴ *Cherkasy regional ecological-naturalistic center, Minor Academy of Sciences, Cherkasy,
Ukraine*

For the first time we calculate and present for individual Cu-Ni nanoparticle the nanomelting and nanosolidification loops at different nanometric sizes at temperature-composition phase diagram. Equilibrium states in two-phase region are investigated from 1000 K up to 1700 K. The limit amount of matter and surface-induced size effects can change the thermodynamics of first order phase transformation so that there are appearance of hysteresis in a form of nonsymmetry for forth and back transforming paths, the existence of compositional splitting and of the loops-like splitted path on the size dependent temperature-composition phase diagram, the difference between the size-dependent phase diagram and solubility diagram, between two-phase equilibrium curves and solubility curves, also intersection of nanoliquidus and nanosolidus. These findings lead to the necessity to reconsider such basic concepts in materials science as phase diagram and solubility diagram.

The work have been done in the framework of German-Ukraine collaboration Project (DAAD reference code A/14/02389).