

DIFFUSIVE PROPERTIES OF TiC AT HIGH TEMPERATURES

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In highly defective solids in which concentration of point defects is higher than 0.1 % interactions between defects become important and have influence on many macroscopic structure sensitive properties of these compounds. For description of interactions between defects in highly defective solids it is necessary to introduce in diffusion theory new terms characterizing interaction energy between defects, especially for the dependence of defect concentration on activity of compound components and temperature and as a result on the effective activation energy of diffusion of defects, atoms or ions and all related on its macroscopic properties of given compounds. The above mentioned function is characteristic for a crystallographic lattice of a compound, different types of defects and their concentrations, attractive or repulsive interactions between defects and for a given diffusion mechanism.

This approach will be discussed and as an example interpretation of TiC properties at high temperatures will be given. TiC can be regarded as a model system for transition metal monocarbides. TiC has very wide phase field, very high melting temperature (3340 K) and very high concentration of defects, vacancies in carbon sublattice, reaching maximum values even over 50%. Many structure sensitive macroscopic properties of TiC have unusual character of its dependencies on defect concentration, passing by extreme at the same composition. This work has been initiated to find the interpretation of such behaviour.

The mobility of carbon vacancies in TiC has been determined in this work as a function of defect concentration in a very wide temperature range (1800 - 3000 K). At constant temperature it decreases markedly, more than one order of magnitude, with carbon vacancy concentration increasing up to 25%, but for defect concentration higher than 30% the defect mobility becomes nearly constant or slightly increases. This fact indicates on the existence of strong interactions in TiC lattice. The influence of strong repulsive interactions between carbon vacancies and stronger than that attractive interactions between titanium atoms on many macroscopic properties of TiC will be shown. The free energy of these interactions, the enthalpy of the mobility of carbon vacancies in TiC has been determined and discussed in this work giving new information on the mechanism of carbon and titanium diffusion in crystallographic lattice of TiC.