THERMODYNAMIC ASSESSMENT OF THE Al_2O_3-MgO-TiO_2 SYSTEM

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The Al_2O_3-MgO-TiO_2 system is of interest for industrial applications: $MgAl_2O_4$-based materials have a good combination of physical and chemical properties such as high refractoriness, high mechanical strength and high resistance to chemical attack, while the addition of Al_2TiO_5 improves thermal shock resistance of spinel. The Al_2O_3-based ceramics are proposed as filter materials for steel and Al-alloy filtration from $MgAl_2O_4$ and Al_2O_3 inclusions. Thus, thermodynamic modelling of the Al_2O_3-MgO-TiO_2 system is important for thermodynamic database development to model interactions in filter material.

To provide an experimental base, Al_2O_3-MgO-TiO_2 samples were prepared by the co-precipitation routine followed by prolong annealing experiments and then characterized using XRD, SEM/EDX, and DTA. Four isothermal sections of the Al_2O_3-MgO-TiO_2 system at $1000-1464°C$ were constructed based on obtained results which are mainly consistent with the literature data [1-2]. Formation of continuous solid solutions with spinel, Mg2TiO4-$MgAl_2O_4$, and pseudobrookite, $MgTi_2O_5$-Al_2TiO_5, structures at high temperatures was confirmed. The solid-state reaction, Al_2O_3 + TiO_2 + Sp s.s. = Psbk s.s., was observed at about 1160°C for the first time. On the liquidus surface, the eutectic invariant reaction between $MgTiO_3$, Psbk s.s and Sp. s.s. was detected at 1602°C. Another invariant reaction of transitional type, L + Al_2O_3 = Sp s.s + Psbk s.s., was observed at 1733°C. Obtained experimental data for the Al_2O_3-MgO-TiO_2 systems were used to derive its thermodynamic database. The compound energy formalism was applied to describe solid solutions, while to describe oxide liquid the two-sublattice partially ionic liquid model was implemented. A special attention was paid to reproducing the degree of inversion when the spinel phase changes from inverse Mg_2TiO_4 to normal $MgAl_2O_4$ and in the pseudobrookite phase from normal $MgTi_2O_5$ to completely disordered Al_2TiO_5.

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