

Thermodynamic study of monoclinic pyrrhotite in equilibrium with pyrite in the Ag-Fe-S system by solid-state electrochemical cell technique

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ABSTRACT

An equilibrium mixture of monoclinic pyrrhotite and pyrite was synthesized in the eutectic $\text{AlCl}_3\text{-KCl}$ melt at 525 K. The reaction $7\text{FeS}_2(\text{cr}) + 12\text{Ag}(\text{cr}) = 8\text{Fe}_{0.875}\text{S}(\text{cr}) + 6\text{Ag}_2\text{S}(\text{cr})$ was studied by an electromotive force technique in an all-solid-state electrochemical cell with an Ag^+ -conductive solid electrolyte in Ar at atmospheric pressure: $(-)\text{Pt} | \text{Ag} | \text{AgI} | \text{Ag}_2\text{S}, \text{Fe}_{0.875}\text{S}, \text{FeS}_2 | \text{Pt} (+)$. In the 490–565 K temperature range a linear electromotive force vs. temperature trend was obtained from which the temperature dependence of the sulfur fugacity was determined for the monoclinic pyrrhotite-pyrite equilibrium: $\log f_{\text{S}_2}(\text{mpo+py}) = 14.079 - 14406 \cdot T^{-1}$, ($500 < T/\text{K} < 565$). In addition, standard thermodynamic functions were calculated for monoclinic pyrrhotite $\text{Fe}_{0.875}\text{S}$ at 298 K and atmospheric pressure: $\Delta G_f^\circ(\text{mpo}, 298.15 \text{ K}) = -(136\,200 \pm 3000) \text{ J/mol}$, $S^\circ(\text{mpo}, 298.15 \text{ K}) = (66.7 \pm 1.3) \text{ J/(mol}\cdot\text{K)}$, $\Delta H_f^\circ(\text{mpo}, 298.15 \text{ K}) = -(157\,400 \pm 3000) \text{ J/mol}$. Gaseous sulfur, S_2 —ideal gas at 1 bar (10^5 Pa) pressure—was taken as a standard state for sulfur.

Keywords: Monoclinic pyrrhotite, thermodynamic properties, sulfur fugacity, electrochemical cell technique, salt flux technique