Physico-Chemical Interaction in Systems Based on Quaternary Compounds Cu(Ag)In(Cr)P_2S_6(Se_6)

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The investigation of phase equilibria in systems based on Cu(Ag)In(Cr)P_2S_6(Se_6) compounds was held with the purpose of studying the possibility of formation of solid solutions. Electronic structure of atoms, ionic and covalent radii, electronegativity of the components, crystal structure data of quaternary compounds, similarity of chemical bonding and structure of initial substances indicate the possibility of formation of solid solutions between them.

In all investigated systems there are substitutional solid solutions where the substitution of singly charged ($Cu^+ \leftrightarrow Ag^+$) and triple charged ($In^{3+} \leftrightarrow Cr^{3+}$) cations and double charged anions ($S^{2-} \leftrightarrow Se^{2-}$) is realizing.

Phase diagrams of these quazibinary systems can be divided into three types according to the type of physico-chemical interaction:

The formation of continuous solid solutions between the initial quaternary compounds ($AgInP_2Se_6$-$CuInP_2Se_6$, $AgInP_2S_6$-$AgInP_2Se_6$).

Peritectic interaction with limited solubility of components ($CuInP_2S_6$-$AgInP_2S_6$, $CuCrP_2S_6$-$AgCrP_2S_6$, $CuInP_2S_6$-$CuInP_2Se_6$).

Eutectic interaction with limited solubility of components ($CuCrP_2S_6$-$CuInP_2S_6$).

We explain that physico-chemical interaction in the studied systems depends on the size of ions, electronegativity, crystal structure data, the type of formation and the difference of melting points of quaternary compounds, as well as the values of average first quantum number, ionic component of chemical bonding and polarization properties of ions.