The Pseudo-Ternary Intermetallic System $CaAg_2$-$CaZn_2$-$CaAl_2$

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The three pseudo-binary intermetallic systems $Ca(Ag_{1-x}Zn_x)_2$, $Ca(Ag_{1-x}Al_x)_2$, $Ca(Zn_{1-x}Al_x)_2$, and the psudo-ternary system $CaAg_2$-$CaZn_2$-$CaAl_2$, were examined by X-ray single crystal and powder diffractometry. The $CeCu_2$-type structure, showed by both the $CaAg_2$ and $CaZn_2$ phases, is maintained in the whole $Ca(Ag_{1-x}Zn_x)_2$ system. The $Ca(Ag_{1-x}Al_x)_2$ system shows the structural sequence: $CeCu_2$-type (x=0-0.1), $MgZn_2$-type (x=0.1-0.6), $MgNi_2$-type (x=0.7-0.9), $MgCu_2$-type (x=1). A simpler sequence occurs in the $Ca(Zn_{1-x}Al_x)_2$ system: $CeCu_2$-type (x=0-0.5), $MgNi_2$-type (x=0.6-0.8), $MgCu_2$-type (x=0.9-1). Within the pseudo-ternary system, four regions occur, corresponding to the cited structural types: the three Laves phase types ($MgCu_2$, $MgZn_2$, $MgNi_2$) and the $CeCu_2$ type. The central composition $Ca_3Ag_2Zn_2Al_2$ belongs to the $MgZn_2$ type.

A structural map collecting the studied phases shows a combined influence of both the size factor and the electron concentration on the distribution of the structure types as a function of the phase composition. Considering the average atomic volume, a sharp volume increase (up to 6.5%) is observed in the regions showing the change from a Laves-phase-type to the $CeCu_2$-type structure, owing to the different geometrical space filling conditions.

Keywords: crystal chemistry and structure, intermetallic compounds, ternary alloys