

Crystal Chemistry, Phase Diagrams, and Thermoelectric Properties of the Ca-M-Co-O (M=Sr, La, Sm, Eu, Gd, and Ho) Systems

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Oxide materials that have high temperature stability are potential candidates for waste heat energy conversion applications. The phase diagrams of the Ca-M-Co-O (M=Sr, La, Sm, Eu, Gd, and Ho) systems were determined. These diagrams offer compatibility relationships in the ternary oxide systems that are essential for processing and for the understanding of thermoelectric properties. In these systems, in addition to the well-known $(\text{Ca}, \text{M})_3\text{Co}_4\text{O}_9$ phase (with misfit layered structure) that has excellent thermoelectric properties, other low-dimensional phases include the homologous series, $\text{A}_{n+2}\text{Co}_n\text{Co}'\text{O}_{3n+3}$ (where A=Ca, and (Ca, Sr)). While the members of the $\text{A}_{n+2}\text{Co}_n\text{Co}'\text{O}_{3n+3}$ series have reasonably high Seebeck coefficients and relatively low thermal conductivity, the electrical conductivity needs to be increased in order to achieve higher figure of merit (ZT) values. This paper discusses our phase equilibria/structure/property studies of selected cobaltates in the Ca-M-Co-O systems.

Keywords: Ca-M-Co-O, crystal chemistry, crystallography, phase diagrams, thermoelectric materials