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Insights into High-Density Intermetallic Solid Solutions Using Synchrotron Radiation

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The formation of solid solutions at ambient conditions is predominantly dictated by atomic size disparities and electronegativity y, as outlined by the Hume-Rothery and Miedema empirical rules. However, the application of high pressure notably enhances density, leading to significant changes in electron distribution and altering the conditions necessary for alloy formation. To explore binary alloys at elevated densities, we demonstrate the application of synchrotron radiation for a systematic investigation into the alkali metal potassium (K) and various transition and noble metals (M) under high-pressure environments. In this study, X-ray diffraction using synchrotron radiation was employed to observe and characterize novel alloys within the K-M systems, focusing on their crystalline structures and phase change and stability. A thorough analysis of these structures and their electronic configurations revealed that the novel K-M compounds discovered here cannot be adequately explained by the existing empirical rules governing alloy formation.

Keyword-1

extreme conditions

Keyword-2

synchrotron radiation

Keyword-3

X-ray microdiffraction

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