Intermediate-valent Cerium in $Ce_2Ru_4Mg_{17}$ and a Group-Subgroup Scheme for $La_9Ru_4In_5$ and $Ce_9Ru_4Ga_5$

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$Ce_2Ru_4Mg_{17}$ was synthesized by high-frequency melting of the elements in a sealed tantalum ampoule. This magnesium-rich compound crystallizes with a new tetragonal structure type: $I\bar{4}2m$, a = 986.75(8), c = 1008.7(1) pm, $wR2$ = 0.0513, 909 F^2 values and 34 variables. The striking structural motifs in the $Ce_2Ru_4Mg_{17}$ structure are slightly bent $CeRu_2$ units with short Ce–Ru distances of 231 pm and additionally a short Ce–Ce distance of 307 pm. These features are a direct consequence of the cerium valence. The $CeRu_2$ units are embedded in a magnesium-rich matrix with a broad range of Mg–Mg distances (291 – 361 pm). Temperature-dependent magnetic susceptibility data show intermediate-valent behavior of the cerium atoms (0.23(5) μ_B per Ce atom) and no magnetic ordering down to 3 K, indicative of almost tetravalent cerium in $Ce_2Ru_4Mg_{17}$. The cerium-rich gallide $Ce_9Ru_4Ga_5$ shows an unusually short Ce–Ru distance of 237 pm for the Ce2 position as a result of an intermediate cerium valence. The structural distortions are discussed on the basis of a group-subgroup scheme for $La_9Ru_4In_5$ (space group $I4/mmm$) and the superstructure variant $Ce_9Ru_4Ga_5$ (space group $I4mm$).

Key words: Intermetallics, Cerium, Intermediate Valence, Group-Subgroup Relation