

The Intermetallic Compounds $\text{GdRe}_2\text{Al}_{10}$ and $\text{TbRe}_2\text{Al}_{10}$, Crystallizing with a Stacking Variant of the $\text{YbFe}_2\text{Al}_{10}$ Type Structure

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Dedicated to Prof. Dr. Reginald Gruehn on the occasion of his 70th birthday

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Intermetallic Compounds, Crystal Structure, Close Packed Layers

The new compounds $\text{GdRe}_2\text{Al}_{10}$ and $\text{TbRe}_2\text{Al}_{10}$ were obtained in well-crystallized form by reaction of the elemental components with an excess of aluminum after dissolving the matrix in hydrochloric acid. They crystallize with a new structure type which has been determined for $\text{TbRe}_2\text{Al}_{10}$ from single-crystal X-ray data: $Cmcm$, $a = 932.2(1)$, $b = 1030.4(1)$, $c = 1803.2(3)$ pm, $Z = 8$, $R = 0.031$ for 1159 structure factors and 77 variable parameters. Of the two terbium sites, one does not have full occupancy with terbium, however, it may have mixed Tb/Al occupancy. The resulting compositions are $\text{Tb}_{0.948(5)}\text{Re}_2\text{Al}_{10}$ or $\text{Tb}_{0.936(3)}\text{Re}_2\text{Al}_{10.064(3)}$, respectively. The terbium atoms are coordinated by 4 Re and 16 Al atoms. The rhenium atoms are situated in distorted icosahedra formed by 2 Tb and 10 Al atoms. The nine different aluminum atoms have between 12 and 14 neighbors (1 or 2 Tb, 2 Re, and between 8 and 11 Al atoms). The structure may be viewed as consisting of two kinds of alternating layers. One of these is puckered, hexagonal close packed, with a mesh content of 4ReAl_3 ; the other is planar and less densely packed. It has the mesh content 2TbAl_4 . The same kinds of atomic layers have been found in the structures of $\text{YbFe}_2\text{Al}_{10}$ and $\text{LuRe}_2\text{Al}_{10}$. Thus, the three structure types may be considered as stacking variants of each other. The tetragonal $\text{CaCr}_2\text{Al}_{10}$ (ordered ThMn_{12}) type structure also belongs to this structural family, although the CaAl_4 layers somewhat differ from the layers TbAl_4 , YbAl_4 , and LuAl_4 .