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Bimetallic derivatives of the $[M(en)_3]^{3+}$ ion ($M = Cr$ and Co): A series of compounds with unusual magnetic and structural properties (abstract)

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The crystal structure and magnetic susceptibility of a series of $[M(en)_3]^{3+}$ ($M = Cr$ or Co) derivatives are described. In particular, the crystalline structures of (1) $[Cr(en)_3]_3[FeCl_6]Cl_6 \cdot H_2O$, (2) $[Co(en)_3]_3[FeCl_6]Cl_6 \cdot H_2O$, and (3) $[Cr(en)_3][FeCl_6] \cdot 11H_2O$ are reported. Structural data, in Å, for these compounds are as follows: (1) space group $R\bar{3}$, $a = 15.447(4)$, $c = 21.060(6)$, $Z = 3$; (2) space group $R\bar{3}$, $a = 15.346(3)$, $c = 20.880(5)$, $Z = 3$; (3) space group $P3c1$, $a = 11.654(3)$, $c = 15.508(4)$, $Z = 2$. The main structural feature of the first two isomorphous materials is that they consist of a three-dimensional network of triangular antiprisms formed by the $[M(en)_3]^{3+}$ ($M = Cr$ or Co) ions and connected with each other by sharing corners. An $[FeCl_6]^{3-}$ ion is placed at the center of each antiprism. Compound (3) contains a sc arrangement of $[Cr(en)_3]^{3+}$ and $[FeCl_6]^{3-}$ octahedra. In addition, the magnetic susceptibilities of the above-mentioned isomorphous compounds and of $[M(en)_3][FeCl_6]$ ($M = Cr$ and Co) and $[Cr(en)_3][InCl_6]$ are reported. While $[Cr(en)_3]_3[FeCl_6]Cl_6 \cdot H_2O$ orders as a ferrimagnet at 0.91 K, $[Cr(en)_3][FeCl_6]$ exhibits antiferromagnetic properties with $T_c = 2.26$ K, a temperature rather similar to the antiferromagnetic ordering temperature of $[Co(en)_3][FeCl_6]$.