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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)$_3$][FeCl$_6$]Cl$_6$·H$_2$O, (2) [Co(en)$_3$][FeCl$_6$]Cl$_6$·H$_2$O, and (3) [Cr(en)$_3$][FeCl$_6$]·11H$_2$O are reported. Structural data, in Å, for these compounds are as follows: (1) space group $R$ 3, $a$ = 15.447(4), $c$ = 21.060(6), $Z$ = 3; (2) space group $R$ 3, $a$ = 15.346(3), $c$ = 20.880(5), $Z$ = 3; (3) space group $P$ 3$_c$1, $a$ = 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)$_3$][FeCl$_6$]Cl$_6$·H$_2$O 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$_6$].

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