Intermetallic Cadmium Compounds M_5T_2Cd (M = Ca, Yb, Eu; T = Cu, Ag, Au) with Mo_5B_2Si-type Structure

Frank Tappe, Christian Schwickert, Matthias Eul, and Rainer Pöttgen

Institut für Anorganische und Analytische Chemie, Universität Münster, Corrensstraße 30, 48149 Münster, Germany

Reprint requests to R. Pöttgen. E-mail: pottgen@uni-muenster.de

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The intermetallic compounds M_5T_2Cd (M = Ca, Yb, Eu; T = Cu, Ag, Au) and Yb_5Cu_2Zn were synthesized by melting the elements in sealed tantalum tubes followed by annealing at 923 K. All phases were characterized on the basis of powder and single-crystal X-ray diffraction data: Mo_5B_2Si type, $I4/mcm$, $Z = 4$, $a = 828.7(1)$, $c = 1528.1(3)$ pm, $wR2 = 0.030$, 440 F^2 values, 16 variables for Eu_5Cu_2Cd, $a = 788.2(1)$, $c = 1459.3(5)$ pm, $wR2 = 0.053$, 378 F^2 values, 16 variables for Yb_5Cu_2Cd, and $a = 797.2(1)$, $c = 1438.8(3)$ pm, $wR2 = 0.036$, 386 F^2 values, 17 variables for $Yb_5Au_{2.19}Cd_{0.81}$, which shows a small degree of Au / Cd mixing. The M_5T_2Cd structures are intergrowth variants of slightly distorted $CuAl_2$- and U_3Si_2-related slabs. Striking coordination motifs (exemplary for Eu_5Cu_2Cd) are square antiprisms of the Eu atoms around Cd, Eu_8 square prisms around Eu, and trigonal Eu_6 prisms around Cu within the AlB_2-related slab. Temperature-dependent magnetic susceptibility measurements showed Pauli paramagnetism for Yb_5Cu_2Zn, indicating purely divalent ytterbium. Eu_5Au_2Cd exhibits Curie-Weiss behavior above 100 K with an experimental magnetic moment of 8.14 μ_B per Eu atom and a Weiss constant of 56 K. Antiferromagnetic ordering of the Eu^{II} magnetic moments is evident at 36 K, and a metamagnetic transition is observed at 25 K and 13 kOe.

Key words: Cadmium, Intermetallics, Magnetic Properties