Physical Review B 2017 vol.96 N13

Interplay of rare-earth and transition-metal subsystems in Cu3Yb(SeO3)2O2Cl

Markina M., Zakharov K., Ovchenkov E., Berdonosov P., Dolgikh V., Kuznetsova E., Olenev A., Klimin S., Kashchenko M., Budkin I., Yatsyk I., Demidov A., Zvereva E., Vasiliev A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

©2017 American Physical Society We present the synthesis and the experimental and theoretical study of the new member of the francisite family, Cu 3 Yb(SeO 3) 2 O 2 Cl. The compound reaches an antiferromagnetic order at T N = 36.7 K and experiences first-order spin-reorientation transition to weakly ferromagnetic phase at T R = 8.7 K evidenced in specific heat C p and magnetic susceptibility χ measurements. Distinctly different magnetization loops in T < T R and T R < T < T N temperature ranges reflect the interplay of rare-earth and transition-metal subsystems. At low temperatures, the saturation magnetization M s ~ 5.2 μ B is reached in pulsed magnetic-field measurements. The electron spin resonance data reveal the complicated character of the absorption line attributed to response from both copper and ytterbium ions. Critical broadening of the linewidth at the phase transitions points to quasi-tw--dimensional character of the magnetic correlations. The spectroscopy of Yb 3+ ions evidences splitting of the lowest-energy Kramers doublet of 2 F 5 / 2 excited multiplet at T R < T < T N while the ground Kramers doublet splits only at T < T R . We describe the magnetic properties both above and below the spin-reorientation transition in the framework of a unified approach based on the mean-field approximation and crystal-field calculations.

http://dx.doi.org/10.1103/PhysRevB.96.134422

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