

Drastic anion substitution effect in deformed pyrochlore lattice $\text{Co}_2(\text{OH})_3\text{Cl}_{1-x}\text{Br}_x$

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This work reports a systematic experimental study on the $\mathbf{S} = 3/2$ Ising magnet $\text{Co}_2(\text{OH})_3\text{Cl}_{1-x}\text{Br}_x$ by using magnetic susceptibility, specific heat measurements and μSR . Recently we found a new $3d$ -electron tetrahedral frustration system $M_2(\text{OH})_3X$ ($M = \text{Cu}, \text{Ni}, \text{Co}, \text{Fe}, \text{Mn}$; $X = \text{Cl}, \text{Br}$), which are characterized by deformed pyrochlore lattices [1-3]. In particular, the cobalt compounds $\text{Co}_2(\text{OH})_3X$ ($X = \text{Cl}$ or Br) showed contrasting magnetic properties for $\text{Co}_2(\text{OH})_3\text{Cl}$ and $\text{Co}_2(\text{OH})_3\text{Br}$. While $\text{Co}_2(\text{OH})_3\text{Cl}$ is ferromagnetic showing a zero-field kagome-ice state below $T_C = 10.5$ K [2], $\text{Co}_2(\text{OH})_3\text{Br}$ showed successive antiferromagnetic transitions at $T_{N1} = 6.2\text{K}$ and $T_{N2} = 4.8\text{K}$, respectively [3], as well as complicated field-induced transitions. In the partially substituted series $\text{Co}_2(\text{OH})_3\text{Cl}_{1-x}\text{Br}_x$, gradual transition from FM to AFM occurred with increasing x (Fig. 1). On the other hand, μSR experiment showed decreased fluctuation and, as a result, the increase of the long-range order part with increasing x [Fig. 2]. Besides, we also observed complicated phase transitions in this mixed system. These results, we assume, reflect the competition between antiferromagnetic coupling for the spins on the kagome lattice plane and ferromagnetic coupling for the spins on the triangle lattice plane.

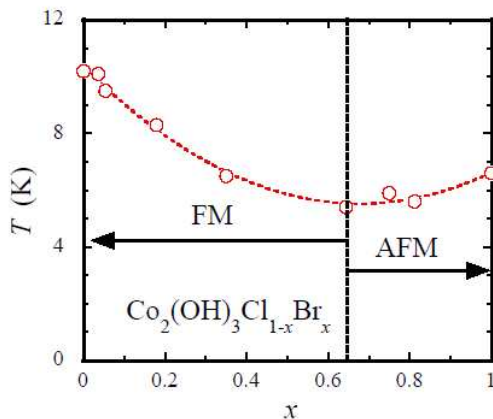


Fig.1 Phase diagram for $\text{Co}_2(\text{OH})_3\text{Cl}_{1-x}\text{Br}_x$.

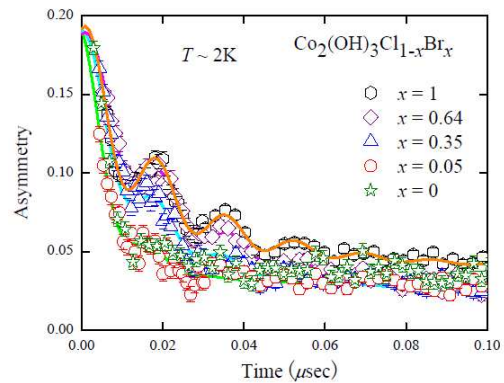


Fig.2 μSR spectra for $\text{Co}_2(\text{OH})_3\text{Cl}_{1-x}\text{Br}_x$.

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