corner-shared octahedra (see Fig. 3) and geometric frustration is expected if the $S=1/2$ moments are located at the Cu2 sites and they are antiferromagnetically coupled. On the other hand, $M_0=3\,\mu_B$ is expected for a ferromagnetic coupling whose value is three times larger than the observed one. Topologically, the same configuration on the magnetic moments is derived when the $S=1/2$ moments are assumed to be at the Re sites (i.e., Re^{6+}). In either case, three $S=1/2$ moments alone do not give a magnetic structure with $M_0=1\,\mu_B$. According to Shannon's ionic radii [12], it is likely that the Cu2 sites are occupied by Cu^{2+} and the Cu1 sites by Cu^{3+} from the Cu–O bond lengths in Table 2, if the ($3Re^{7+}$, Cu^{3+}, $3Cu^{2+}$, Ca^{2+}) configuration is the case. Then, a ferrimagnetic structure which gives $M_0=1\,\mu_B$ may be derived by assuming high spin state of Cu^{3+} ($S=1$) at the Cu1 site and Cu^{2+} ($S=1/2$) at the Cu2 site and an antiferromagnetic correlation between them.

However, we cannot rule out the ($3Re^{6+}$, $4Cu^{3+}$, Ca^{2+}) configuration or other configuration which results from the deviation of composition from the stoichiometric one. NMR, neutron diffraction, electron energy loss spectroscopy (EELS) and band structure calculation studies are in progress. We need to wait their results for further consideration of the magnetic structure.

4. Conclusion

New phases $Sr_8ARe_3Cu_4O_{24}$ (A = Sr,Ca) were discovered under high-pressure/high-temperature condition of 6 GPa and 1300–1350°C. Rietveld analysis of X-ray powder diffraction for the Ca-containing phase indicated an ordered perovskite-type structure with a cubic lattice of ~ 8 Å. The unit cell contains eight perovskite-like blocks and their A-sites are occupied by Sr exclusively. Three metals of Ca(Sr), Re and Cu are located at the B-sites in an ordered way. When these phases were prepared under high-oxygen-pressure condition, they showed ferromagnetism at room temperature. The Ca-containing phase had a unusually high T_c of 440 K as a cuprate, with a spontaneous magnetization of $\sim 1\,\mu_B$/f.u.

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