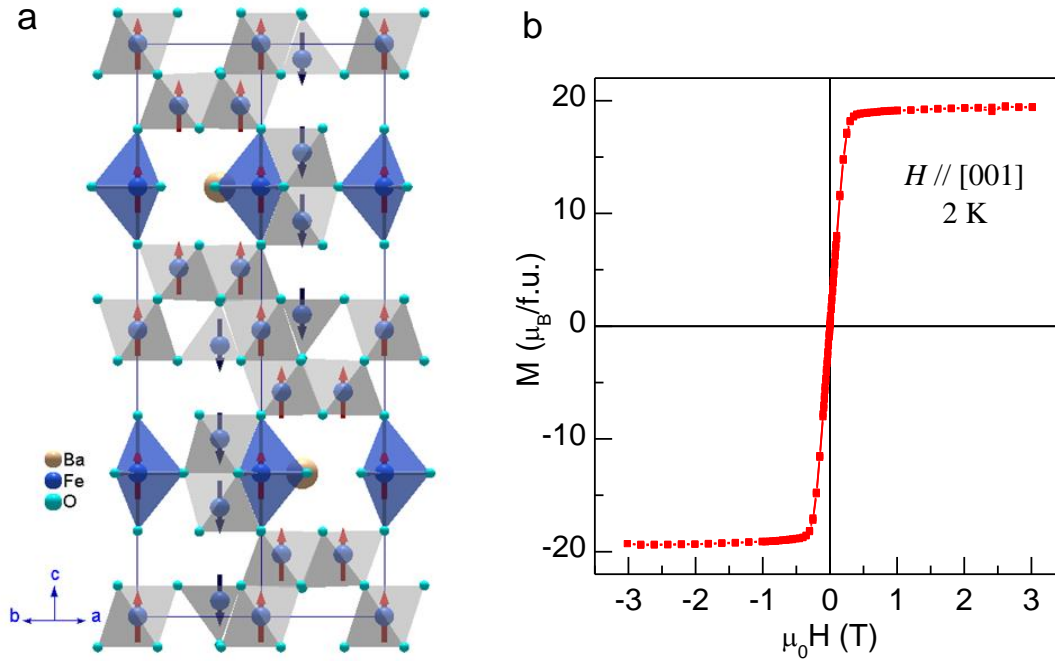
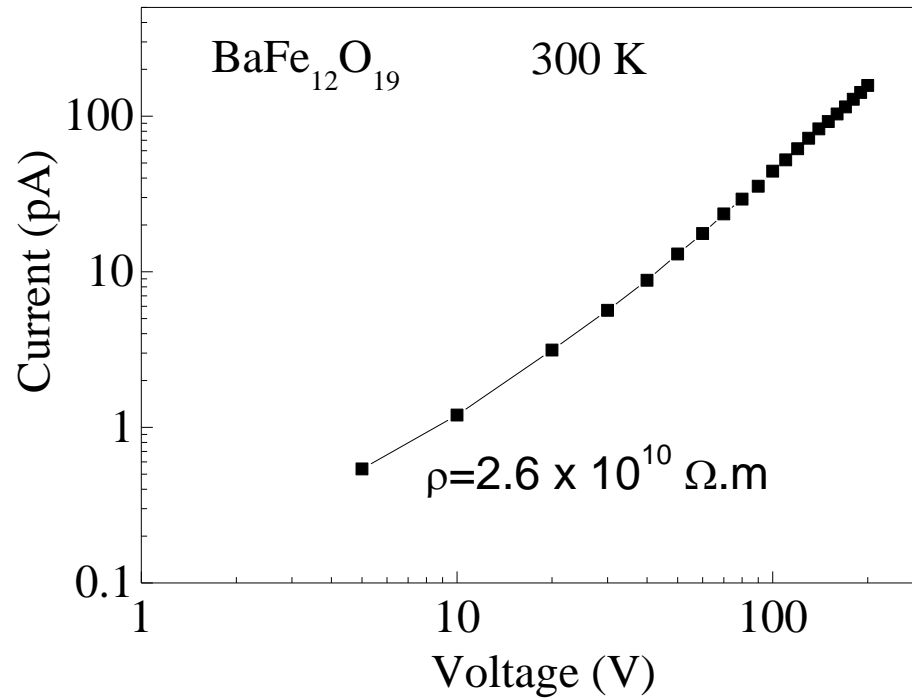


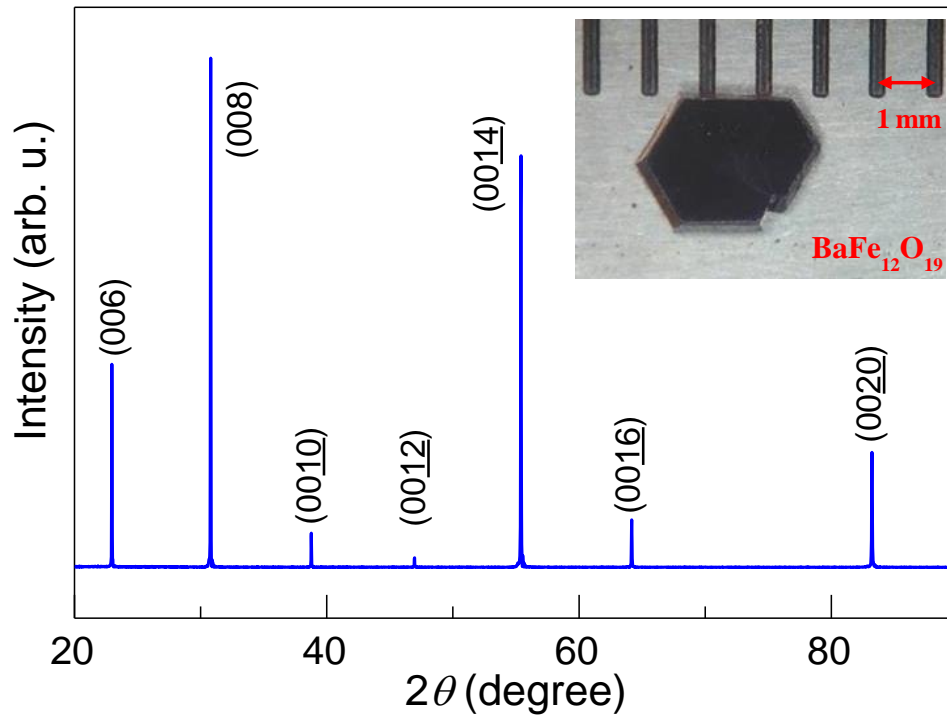
## Supplementary Information



**Supplementary Fig. 1** (a) Magnetic structure of BaFe<sub>12</sub>O<sub>19</sub>. The magnetic moments at the FeO<sub>5</sub> bipyramidal sites are parallel to each other so that there is no magnetic frustration on the triangular lattice. (b) The  $M$ - $H$  hysteresis curve of BaFe<sub>12</sub>O<sub>19</sub> measured at 2 K along  $c$  axis. It is consistent with a long-range collinear ferrimagnetic ordering.



**Supplementary Fig. 2** The *I-V* characteristic along *c* axis of BaFe<sub>12</sub>O<sub>19</sub> measured at room temperature. The sample is highly insulating even at room temperature with a resistivity more than 10<sup>10</sup> Ω.m, suggesting a good quality of the grown single crystals.



**Supplementary Fig. 3** The single-crystal x-ray diffraction pattern of  $\text{BaFe}_{12}\text{O}_{19}$  at room temperature. The inset shows a picture of flux-grown single crystals.