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High magnetic performance in Al-substituted $BaFe_{12}O_{19}$ by a wet chemical process

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A wet chemical process has prepared Al-substituted barium ferrite nanoparticles $BaFe_{11}AlO_{19}$. Structural and magnetic properties of $BaFe_{11}AlO_{19}$ powers were characterized with an X-ray diffractometer, a vibrating sample magnetometer, and a Mössbauer spectroscopy. The results of X-ray diffraction measurements showed that the $BaFe_{11}AlO_{19}$ had an *M*-type hexagonal structure with lattice parameters a_0=5.871, c_0=23.190 Å and X-ray density ρ_X =5.194 g/cm^3. The particle size was 37 nm. Mössbauer spectra of $BaFe_{11}AlO_{19}$ measured at various absorber temperatures of 15–800 K. Its Curie temperature is found to be 700 ± 5 K. The average hyperfine field H_{hf}(T) of the $BaFe_{11}AlO_{19}$ shows a temperature dependence of $[H_{hf}(T)-H_{hf}(0)]/H_{hf}(0)=-0.34(T/T_C)^{5/2}-0.05(T/T_C)^{3/2}$ for $T/T_C<0.7$, indicative of spin-wave excitation. The anisotropy fields H_A was 21.2 kOe and anisotropy constant K_1 was 2.86×10^6 erg/cm^3 at room temperature, as determined the law of approach to saturation (LAS). The saturation magnetization was 44.3 emu/g and the coercivity was 7.56 kOe.