Supporting Information for

Direct observation of dynamical magnetization reversal process governed by shape anisotropy in single $NiFe_2O_4$ nanowire

Junli Zhang,‡[a,c] Shimeng Zhu,‡[a], Hongli Li,[a] Liu Zhu,[a] Yang Hu,[a] Weixing Xia,[b] Xixiang Zhang,[c] Yong Peng*[a] and Jiecai Fu*[a]

[a]Key Laboratory of Magnetism and Magnetic Materials of the Ministry of Education, Lanzhou University, Lanzhou 730000, P. R. China

[b]Key Laboratory of Magnetic Materials and Devices, Ningbo Institute of Material Technology and Engineering, Chinese Academy of Sciences, Ningbo 315201, P. R. China

[c]Division of Physical Science and Engineering, King Abdullah University of Science and Technology (KAUST), Thuwal 239955, Kingdom of Saudi Arabia.

*Corresponding authors

E-mail: pengy@lzu.edu.cn (Yong Peng) and fujc@lzu.edu.cn (Jiecai Fu)

‡These authors contributed equally to this work.

Crystalline structure and chemical analysis of $NiFe_2O_4$ single-particle-chain nanowire

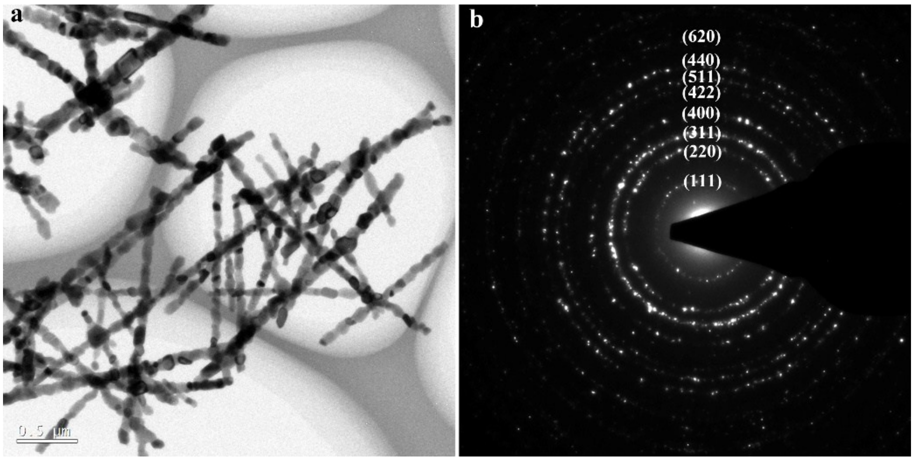

Figure S1. (a) The TEM image of $NiFe_2O_4$ NWs; (b) The corresponding SAED.

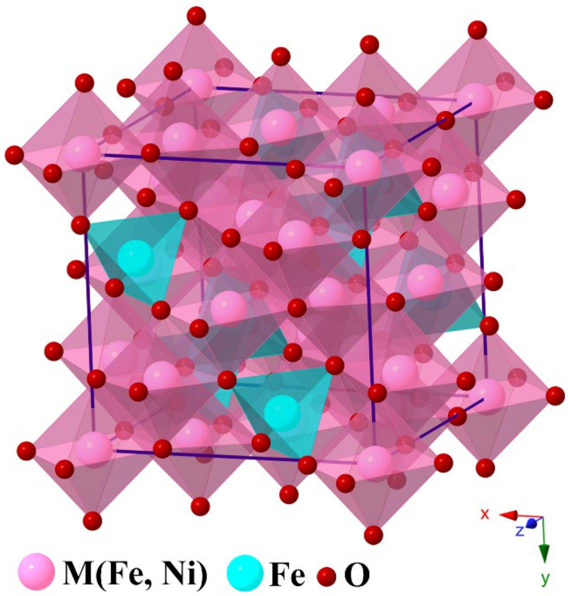

Figure S2. Polyhedral model of cubic spinel nickel ferrite, showing a face-centered cubic network of O^{2-} anions with Ni^{2+} and Fe^{3+} cations occupying two interstitial sites. Half of Fe^{3+} cations occupies tetrahedral-A sites marked by cyan. The other half of Fe^{3+} and Ni^{2+} cation randomly occupy octahedral B sites marked by pink.

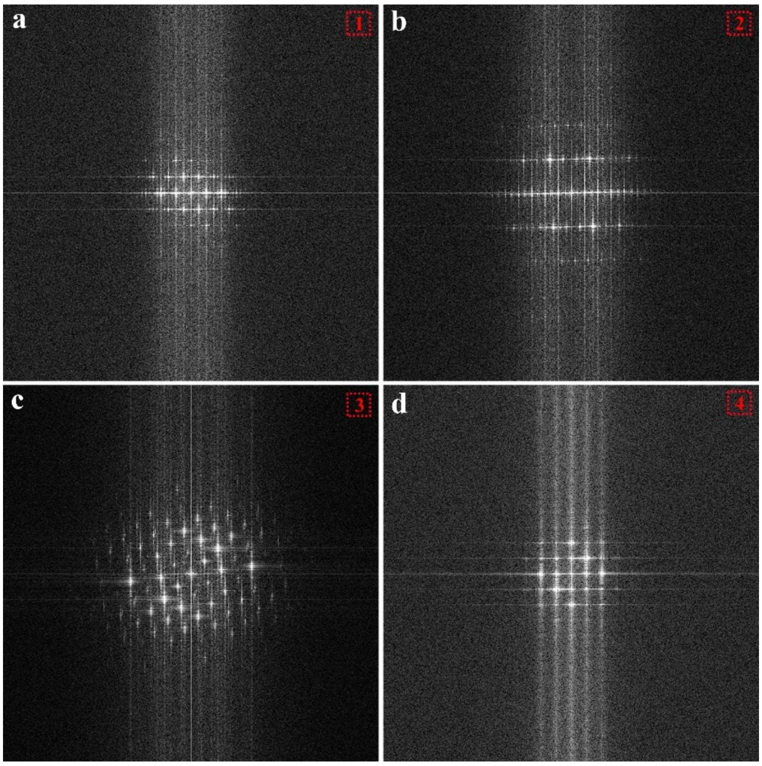

Figure S3. The corresponding FFT for experimental high angle angular dark field-scanning transmission electron microscopy (HAADF-STEM) images in Figure 1.

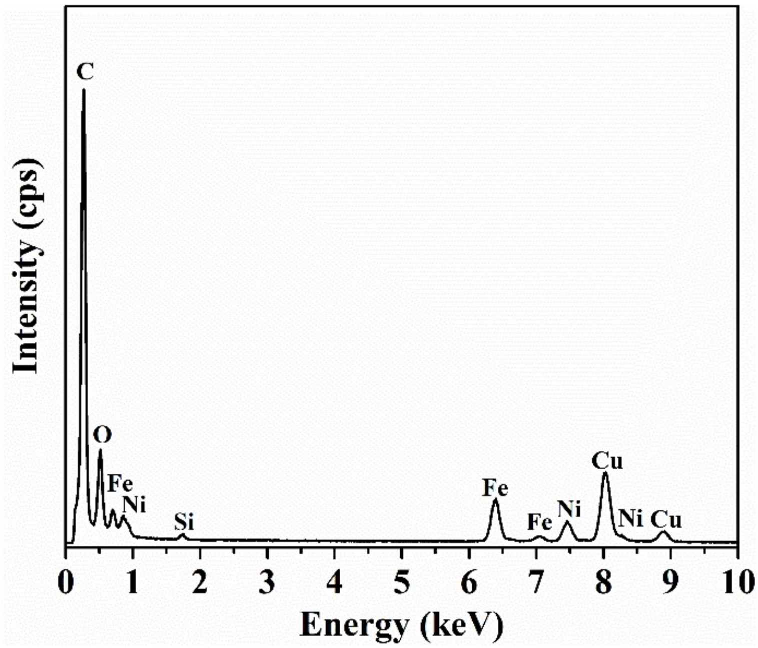

Figure S4. The EDX spectrum acquired from the area in Figure S1a.

Magnetic properties of $NiFe_2O_4$ nanowire.

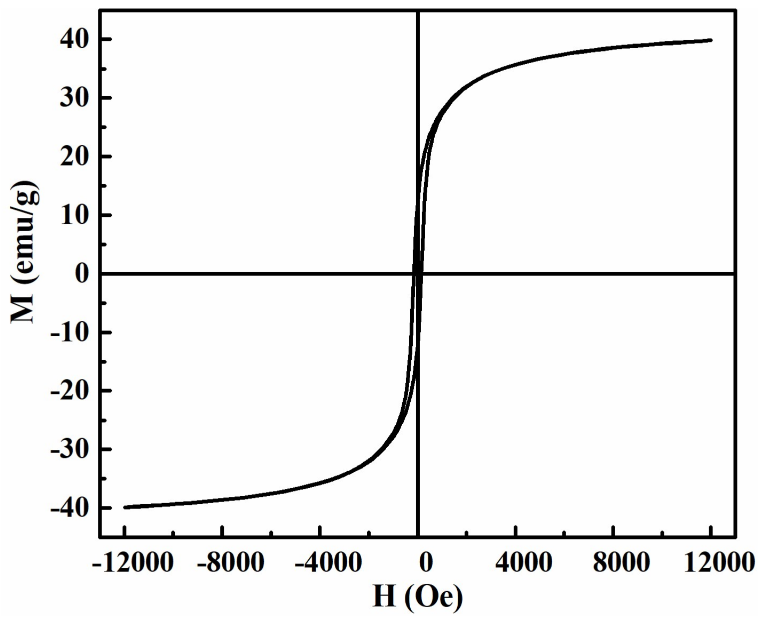

Figure S5. Hysteresis loop of the $NiFe_2O_4$ NWs.

Detail of the magnetization reversal mechanism

Coherent rotation diameter D (D_{coh}=3.655l_{ex} for one-dimensional magnetic materials) is regarded as criteria to judge which magnetization reversal mechanism may occur in magnetic materials. When the diameter D of NW is smaller than D_{coh}, coherent rotation occurs. Conversely, curling (incoherent) rotation happens when R is larger than D_{coh}. l_{ex} is exchange length, given by:

$$l_{ex} = \sqrt{\frac{A}{\mu_0 M_s^{\ 2}}} \tag{1}$$

where, A is exchange constant, 1.15×10^{-6} erg·cm^{-1} for $NiFe_2O_4$, μ_0 is permeability of free space, $4\pi\times10^{-7}$ N/A^2, and M_s is the saturated magnetization, 270 emu/cm^3 for our samples. D_{coh} of $NiFe_2O_4$ NW is 81.8 nm, a little small than the diameter (91nm) of NW in Figure 3. Therefore, the magnetization reversal mechanism of this $NiFe_2O_4$ NW is curling rotation mode, consistent with above observed results.