Supplemental Information

Terahertz spin-wave waveguides and optical magnonics in one-dimensional NiO nanorods

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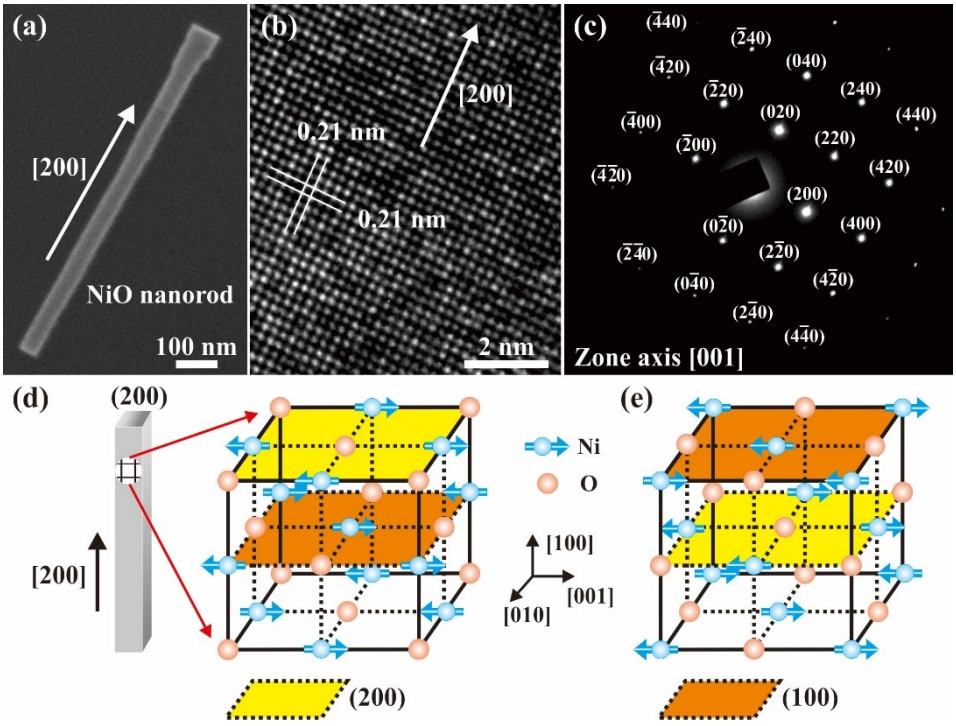

Figure S1. Cubic crystal structure of a 1D NiO nanorod with the (200) top face. (a) The TEM image shows a single 1D NiO nanorod, which is around 890 nm long and 70 nm wide. (b) The high-magnification TEM image displays the atomic-resolution lattice planes of the single 1D NiO nanorod. The lattice surface has a 1×1 structure, with both the lattice constants between the lattice planes being 0.21 nm. The lattice results indicate that the 1D NiO nanorod is a simple cubic crystal. (c) The SAED pattern shows a set of symmetric diffraction spots labeled by various Miller indices, implying that a single 1D NiO nanorod growing along the [200] direction. The SAED pattern, taken from the selected area in (b), is indexed to the [001] zone axis. Since the single 1D NiO nanorod grows along the [200] direction, the flat square end of the nanorod is most likely to be the (200) surface. (d) According to the TEM and SAED results, the 1D NiO

nanorod has a simple cubic structure. The top face of the simple cubic structure is the (200) surface highlighted in yellow. The (200) surface contains five oxygen (represented by red balls) and four nickel atoms (represented by blue balls), one more oxygen atom than nickel atom, so the (200) surface of the NiO is an oxygen-rich surface. (e) A typical simple cubic NiO structure is shown. The top face, the (100) surface, is highlighted in orange. In comparison to the (200) surface, the (100) surface of NiO is nickel-rich, because the number of oxygen atoms is one less than that of the nickel atoms. In the simple cubic NiO structure, each nickel atom possesses a spin (represented by a blue arrow), which are arranged in antiparallel orientations. The (200), (100) and (010) surfaces are the in-plane antiferromagnetic surfaces, with only the (001) surface being an out-of-plane antiferromagnetic surface.

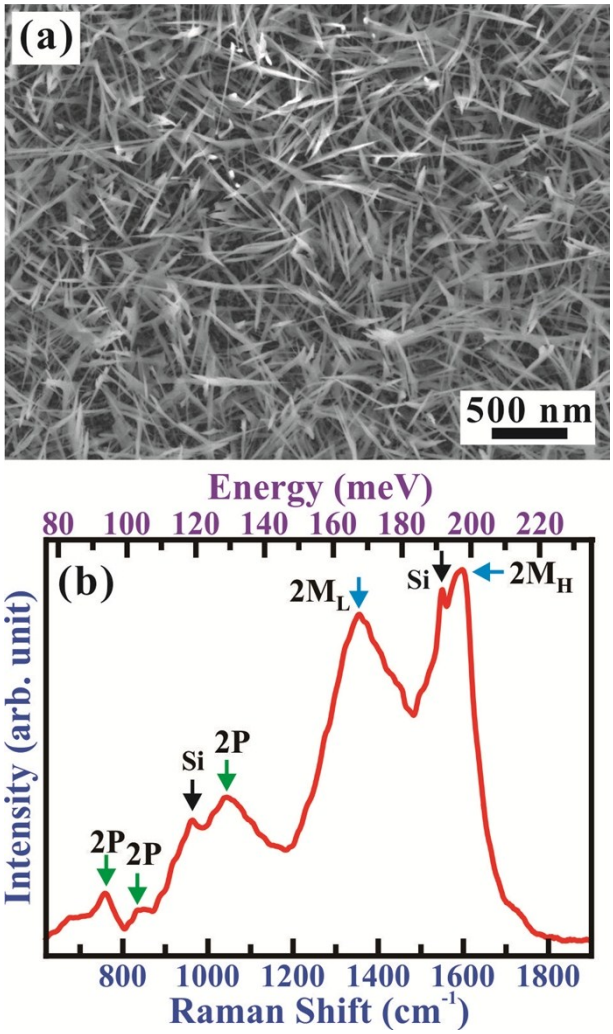

Figure S2. Raman scattering from the 1D NiO nanoneedles lying on the Si substrate. (a) FESEM images of the as-synthesized 1D NiO nanowires lying on the Si substrate; (b) Raman spectra of the sides of the 1D NiO nanoneedles. Evidently, with the exception of the 2P Raman bands, only the $2M_L$ and $2M_H$ Raman bands appear. The 2M Raman band is absent in the Raman spectra.