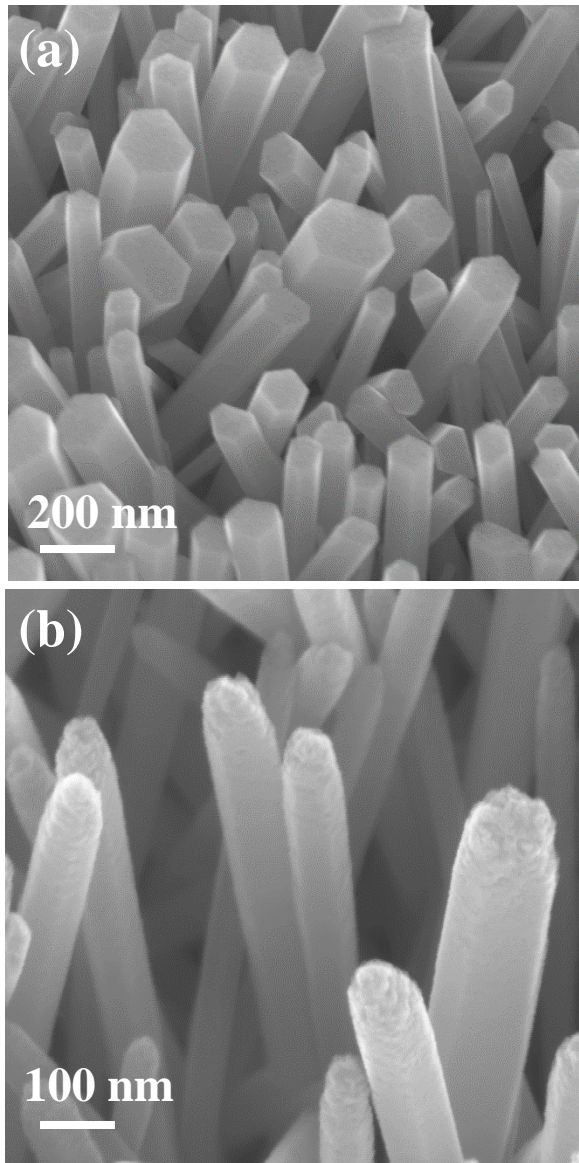


# **Cl-Doped ZnO Nanowires with Metallic Conductivity and Their Application for High-Performance Photoelectrochemical Electrodes**

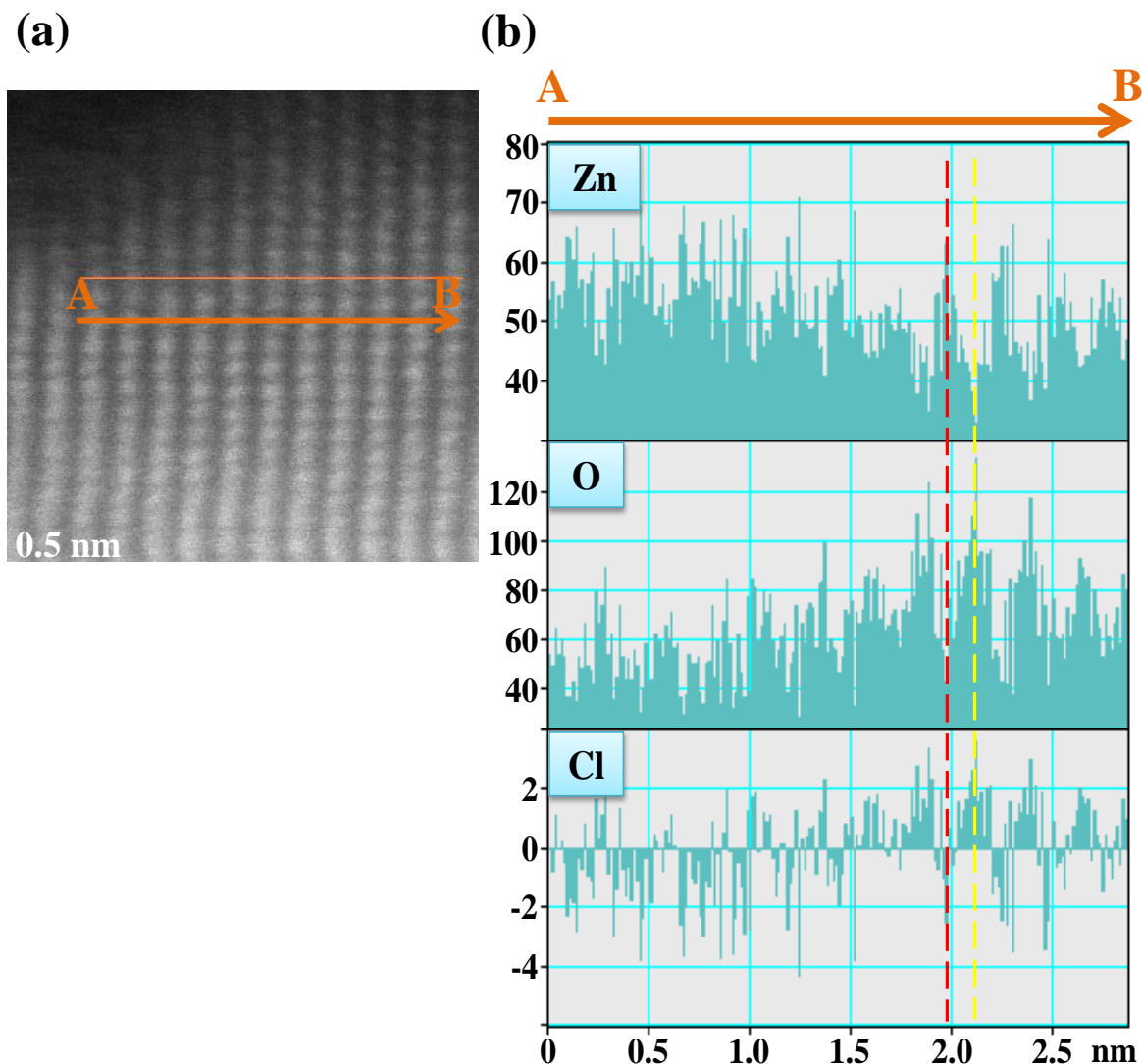
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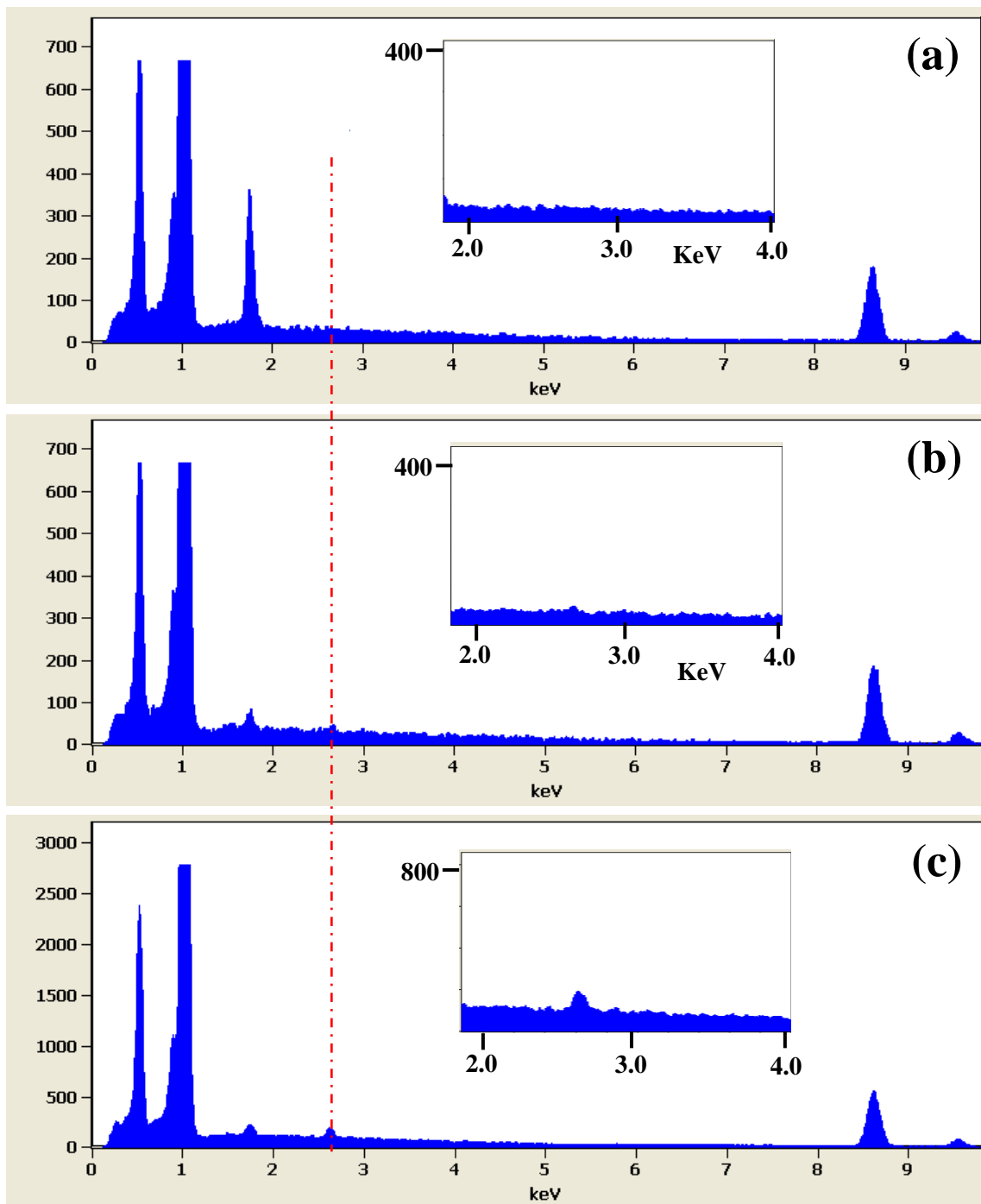
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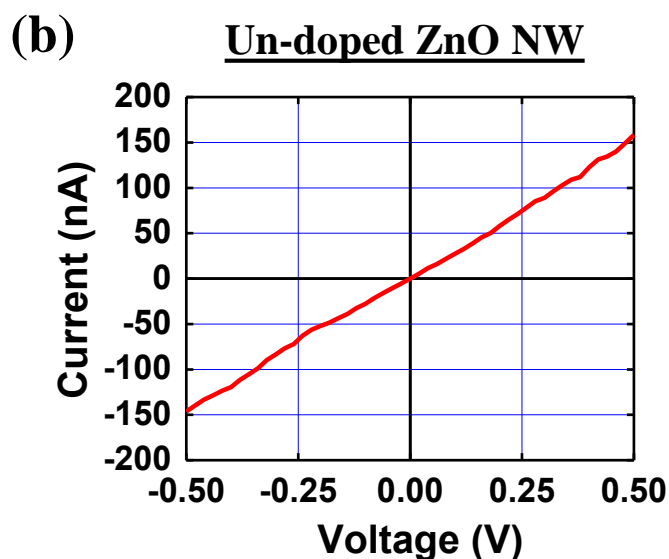
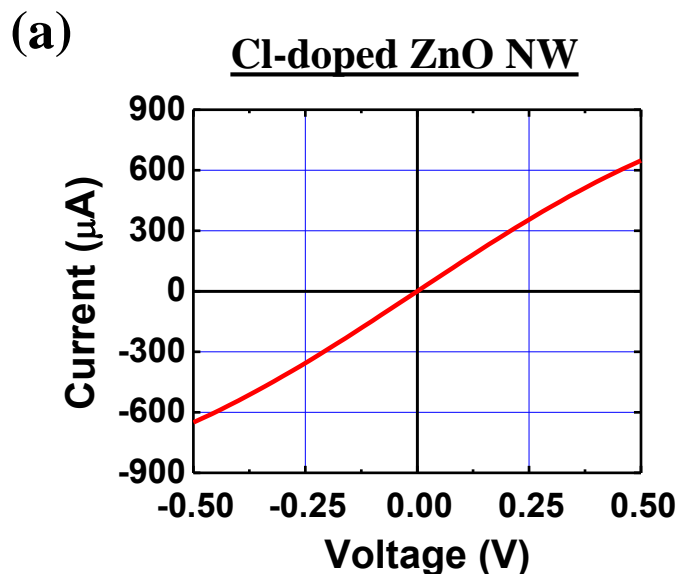
**Figure S1.** SEM images of Cl-doped ZnO NWs when the Cl precursor was (a) KCl and (b) NH<sub>4</sub>Cl.



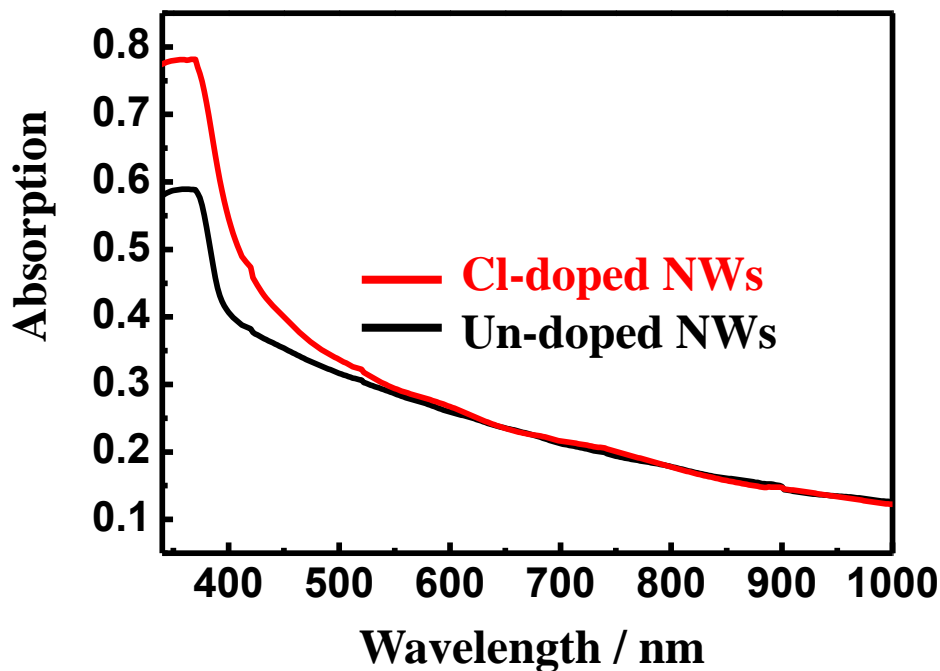
**Figure S2.** (a) A dark field STEM image of Cl-doped ZnO NW. The bright spots were Zn columns while O columns could not be resolved. EELS line profiles of Zn, O, and Cl were acquired from A to B and is shown in (b) where the peaks represent where the atom columns of interest were located. Comparing Zn profile to O profile, we found that Zn and O columns appeared alternatively along the [002] scanning line. This is consistent with the Wurtzite structure and therefore validated our EELS analysis. While examining Cl profiles, we found that Cl signals were obtained precisely at O columns but were absent at Zn columns. The red dashed line in (b) labels a zinc column where there is no oxygen or chlorine signal while the yellow dashed line in (b) labels an oxygen column where chlorine has a peak signal and zinc doesn't.



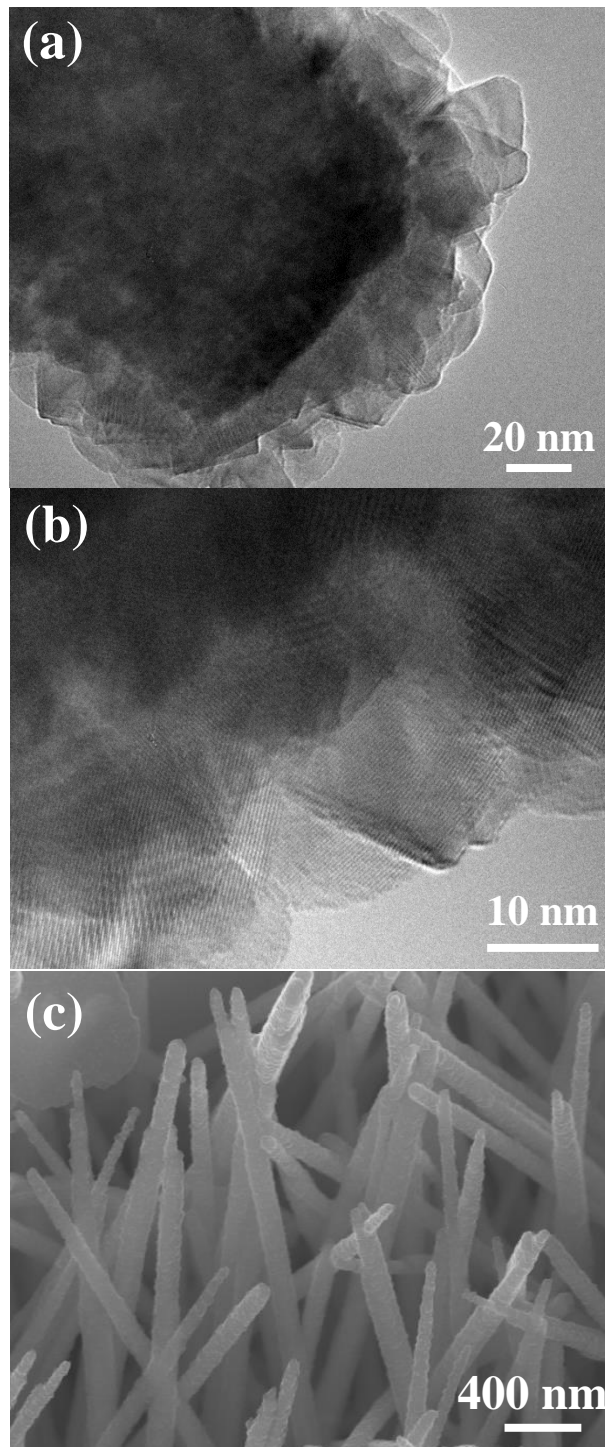
**Figure S3.** EDX spectra of Cl-doped ZnO NWs when the growth solution was added with (a) ZnCl<sub>2</sub> (b) ZnCl<sub>2</sub> and HOAc (3) 25 mM KCl. The dashed red line labels the Cl peak position. The insets in each figure are enlarged views of the Cl peaks.



**Figure S4.** I-V curves of (a) Cl-doped and (b) undoped ZnO NWs representing a two-terminal measurement of the resistivity of them. Combining SEM measurement of the NW dimensions, the resistivity was  $2 \times 10^{-5} \Omega \cdot \text{m}$  for Cl-doped ZnO NWs and  $8 \times 10^{-2} \Omega \cdot \text{m}$  for un-doped ZnO NW.



**Figure S5.** UV-Visible light absorption spectroscopy of (red) Cl-doped and (black) undoped ZnO NWs grown on microscopy glass slides. A bare glass slide was used as background. No absorption peaks were observed except for the band gap absorption. The small bumps at 425, 520, and 895 nm are artifacts that were resulted when the instrument changed optics for different wavelength range.



**Figure S6.** (a) Tip and (b) side surface areas of a Cl-doped ZnO NW coated with polycrystalline anatase  $\text{TiO}_2$ . We didn't observe any exposed area along ZnO NWs. (c) SEM image of Cl-doped ZnO NW array coated with  $\text{TiO}_2$ .