Supplementary Information

Stereo-epitaxial Growth of Single-crystal Ni Nanowires and Nanoplates from Aligned Seed-crystals

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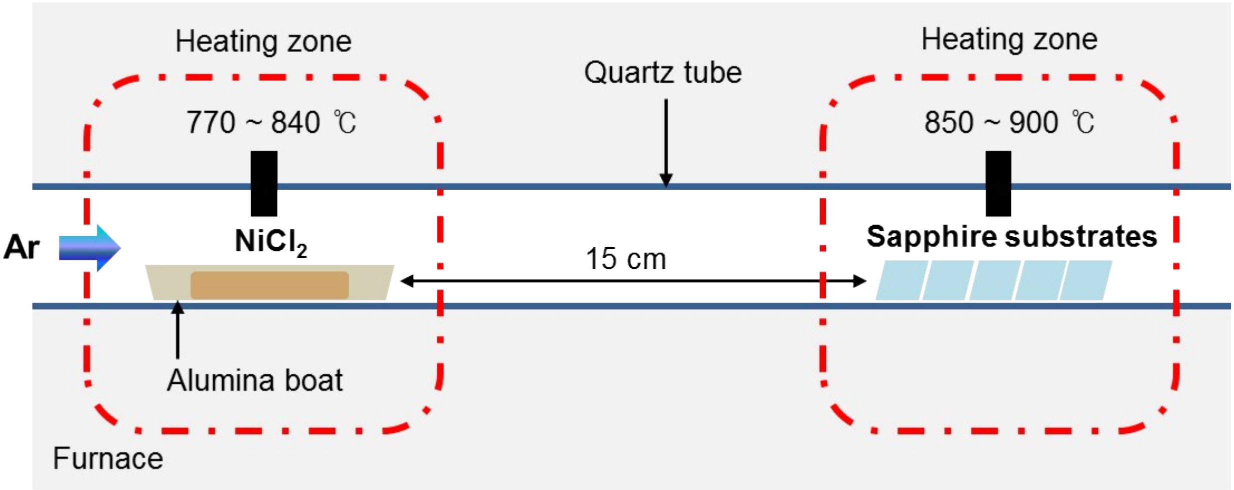

Fig. S1 Experimental scheme for chemical vapor deposition (CVD) method to synthesize the single-crystal Ni nanowires (NWs) and nanoplates on sapphire substrates. We positioned alumina boat with $NiCl_2$ (anhydrous) precursor in a quartz tube, and removed moisture through 200 ~ 300 °C of preheating.

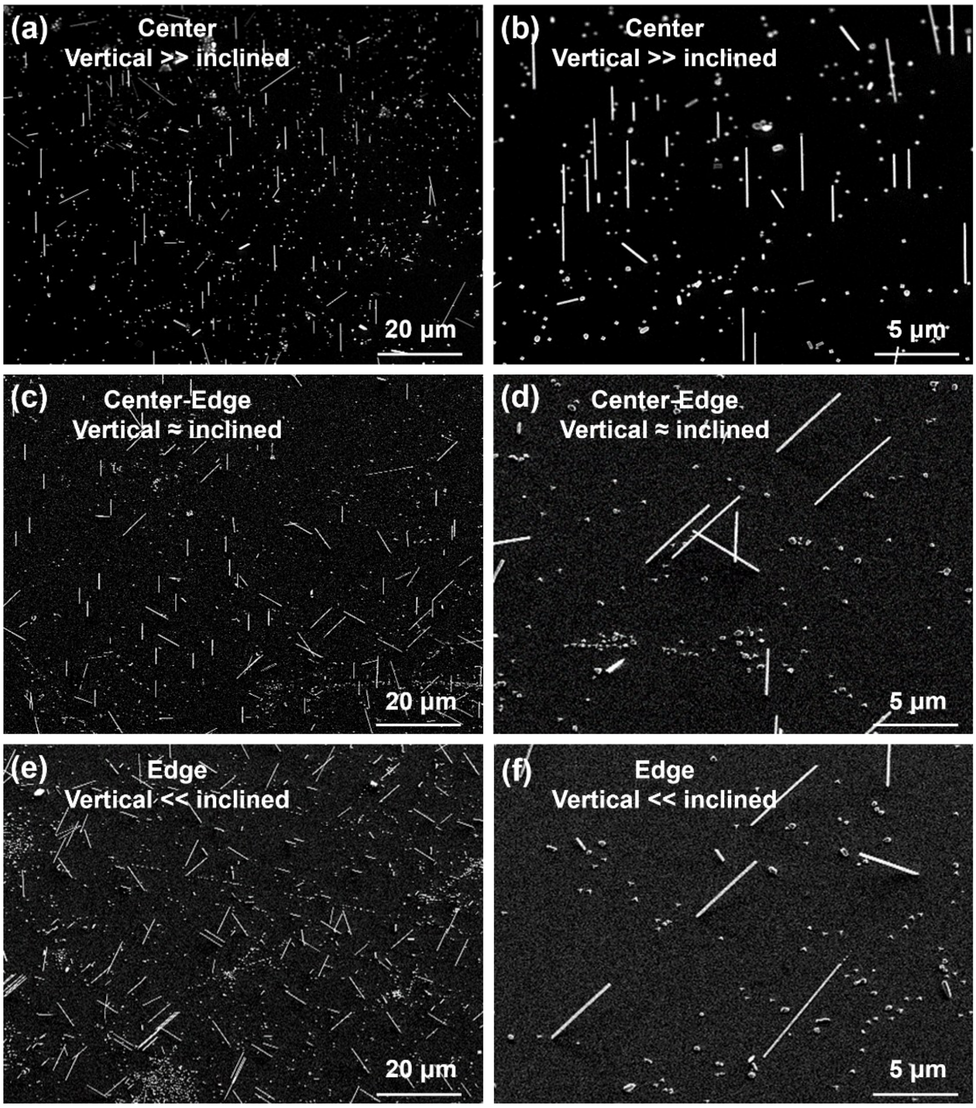

Fig. S2. SEM images of Ni NWs showing growth patterns at different substrate locations on *c*-Al_2O_3 substrates (45°-tilted view). (a, b) At the center of the substrate, vertical growth of Ni NWs is dominant. (c, d) At the middle position between the center and the end edge of the substrate, vertical and inclined Ni NWs grow in a similar density. (e, f) At the end edge of the substrate, inclined growth of Ni NWs is dominant.

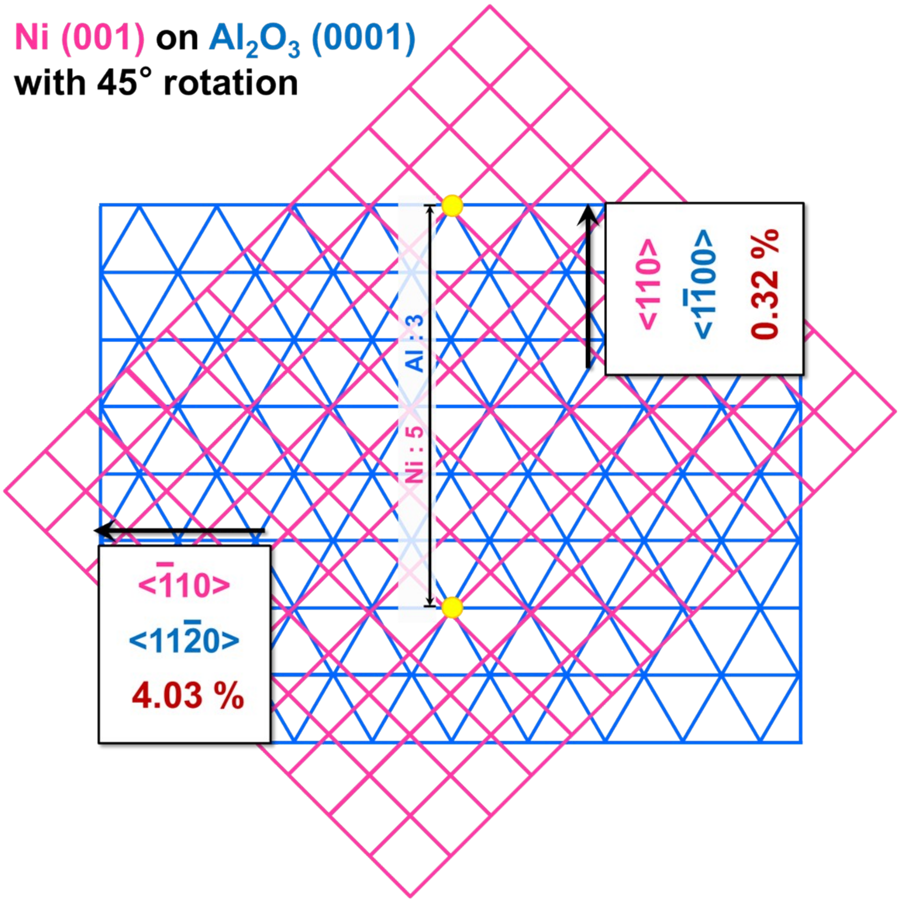

Fig. S3. Minor orientation of cubic Ni seeds on a *c*-Al_2O_3 substrate which is 45° angled to main orientation also has a good domain matching epitaxy with 4.03 % and 0.32 % of misfits along Ni <$\bar{1}$10>//Al_2O_3 <11$\bar{2}$0> and Ni <110>//Al_2O_3 <1$\bar{1}$00> directions, respectively.

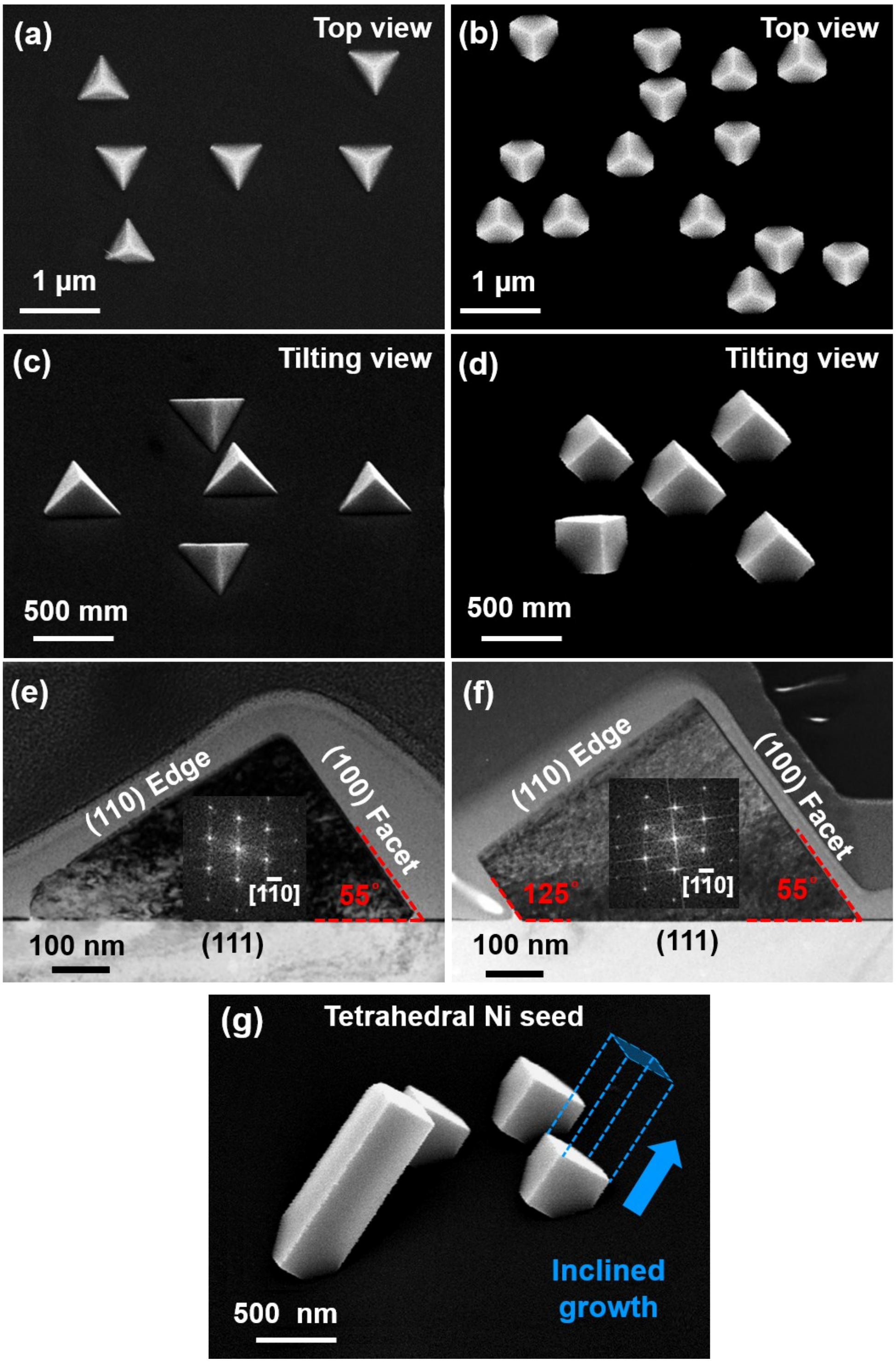

Fig. S4. Ni nanocrystals in (b,d) are considered to have grown from Ni nanocrystals shown in (a,c). (e,f) Cross-sectional TEM images of the nanocrystals in (a,c) and (b,d), respectively, show that they have the same crystallographic structures. (g) Nanorods having different lengths grew in the same tilt angle.

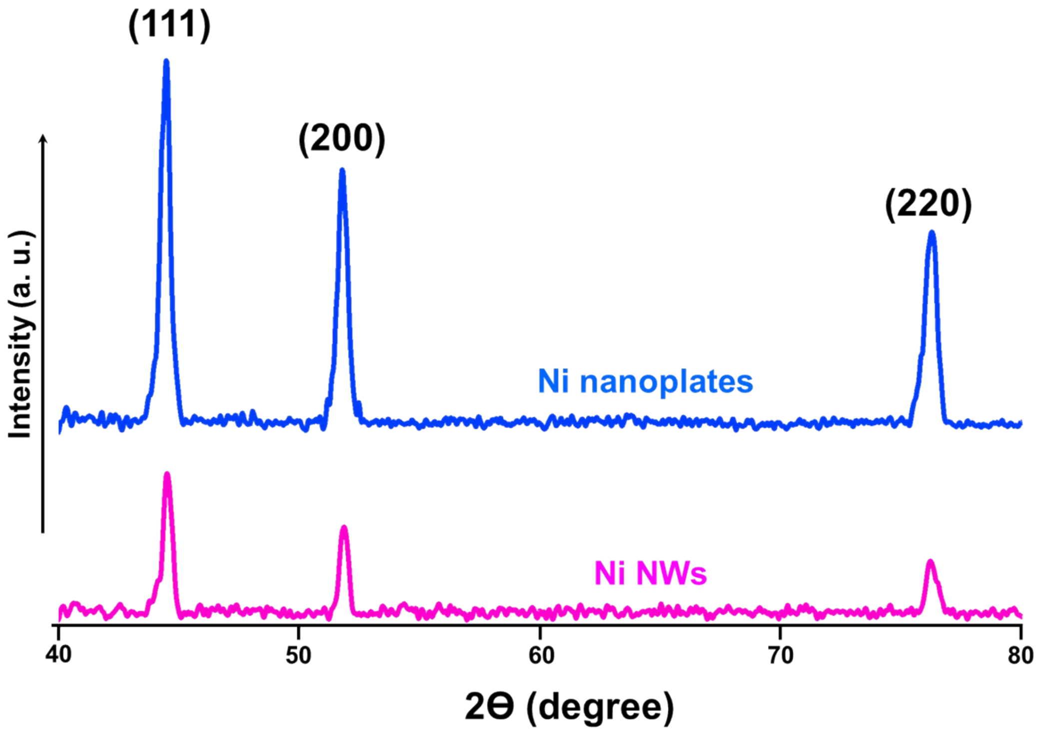

Fig. S5. All peaks for X-ray diffraction (XRD) patterns of Ni NWs and nanoplates correspond well to those for an *fcc* Ni structure (JCPDS 7440-02-0). To obtain the XRD peaks of only the Ni nanostructures without substrate peaks, the detector scan was done with a much reduced incident angle between X-ray and the substrate, so Ni {110} peak could be observed in addition to Ni {100} and Ni {111} peaks that are interfacial planes of Ni nanostructures.

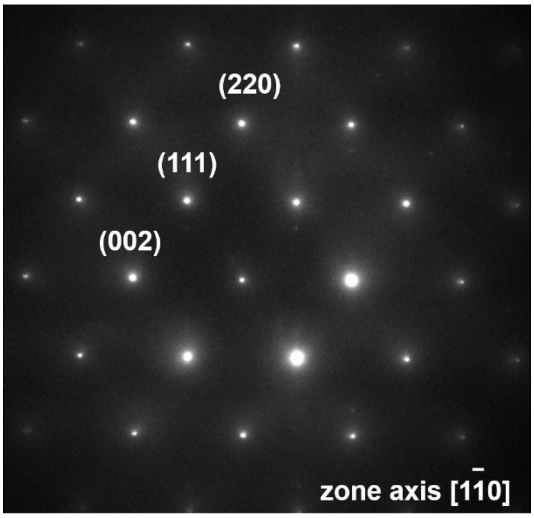

Fig. S6. SAED pattern of Ni nanoplate showing single-crystallinity for the entire structure

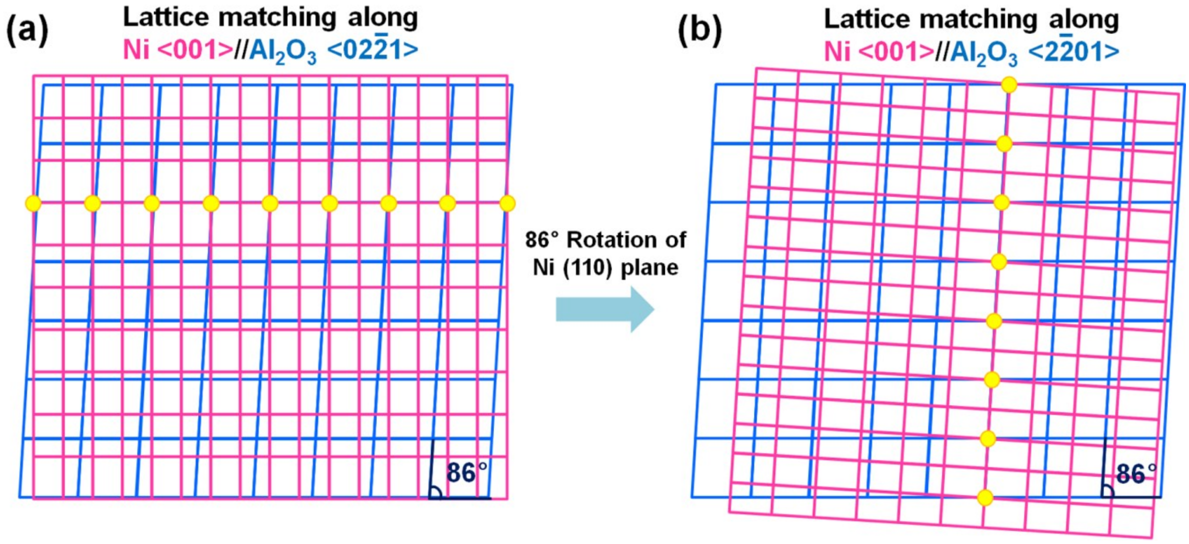

Fig. S7. Because each Al atoms can match individually to each Ni atoms along Ni <001>//Al_2O_3 <02$\bar{2}$1> direction. Al_2O_3 (02$\bar{2}$1) and Al_2O_3 (2$\bar{2}$01) planes have the same lattice spacing and they are 86° angled to each other. Therefore, Ni atoms can sit down equally well energetically along Ni <001>//Al_2O_3 <02$\bar{2}$1> and Ni <001>// Al_2O_3 <2$\bar{2}$01> directions. This is why vertical Ni nanoplatelets have two kinds of orientations with an angle of 86° on a *r*- Al_2O_3 substrate.

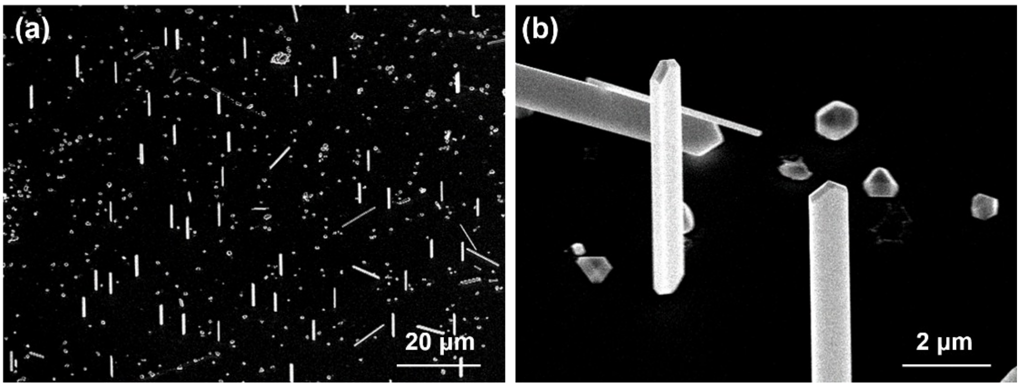

Fig. S8. 45°-tilted SEM images of vertically grown Ni nanobelts on a c-Al_2O_3 substrate (the substrate temperature is 1,050 °C).

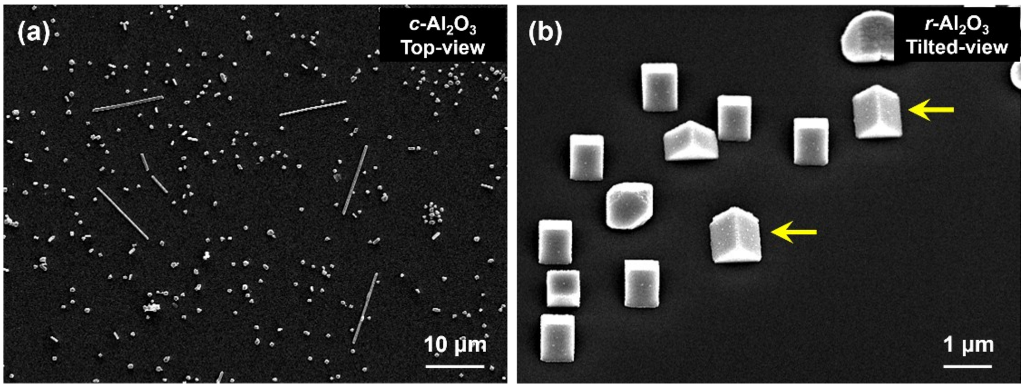

Fig. S9. (a) Top-view SEM image of horizontally grown Ni NWs on a c-Al_2O_3 substrate. (b) 45°-tilted SEM image of horizontal short Ni nanorods (yellow arrows) grown from triangular Ni nanocrystals on a r-Al_2O_3 substrate. Initial amount of $NiCl_2$ precursor was increased by three times.

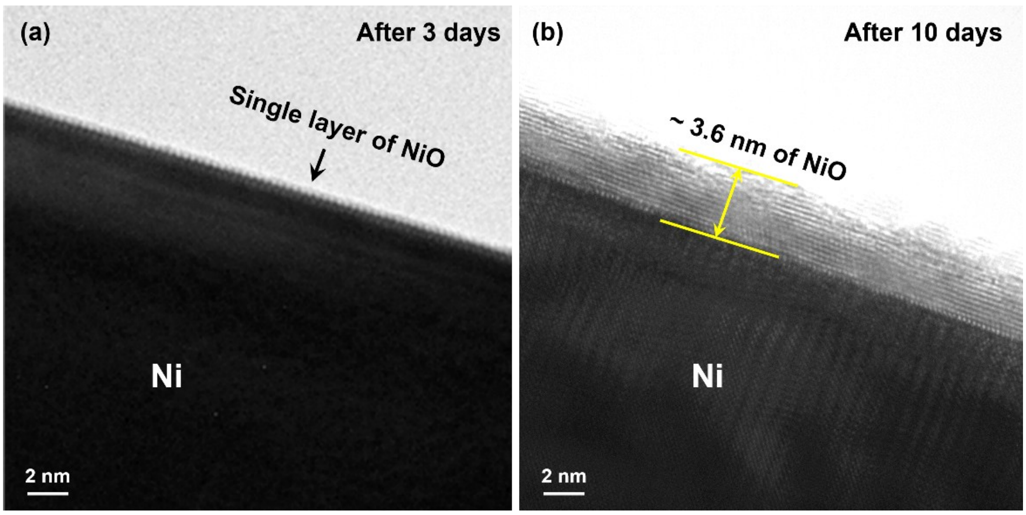

Fig. S10. (a) A single atom layer of NiO is formed on Ni NWs at room temperature after 3 days. (b) A NiO layer ~ 3.6 nm thick is formed on Ni NW surface after 10 days.