

Supporting information

## Local heteroepitaxial growth to promote the selective growth orientation, crystallization and interband transition of sputtered NiO thin films

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### 1. Influence of Cu<sub>2</sub>O seed layer thickness on the preferred orientation of NiO

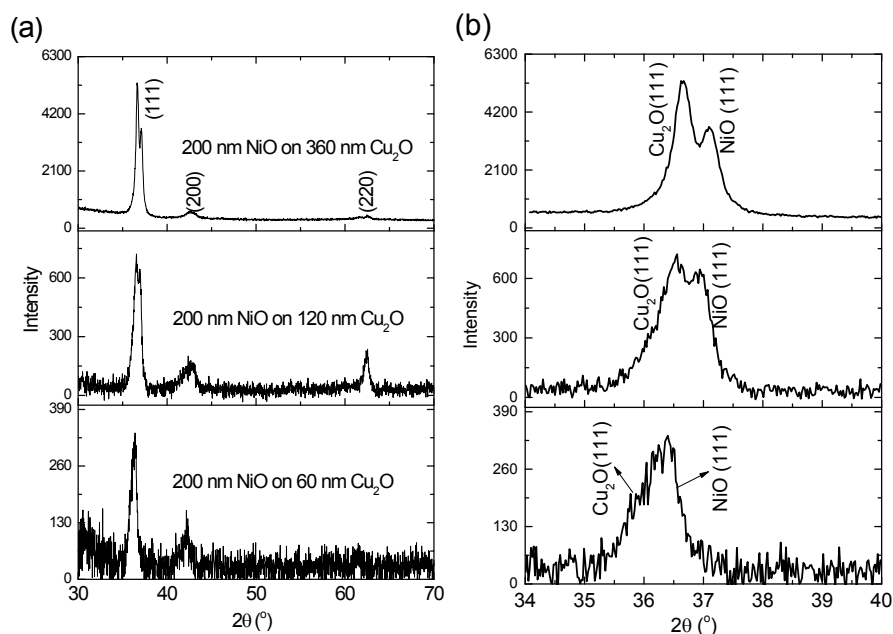


Fig. S1: (a) X-ray diffractograms of 200 nm NiO deposited on Cu<sub>2</sub>O seed layers with different thickness. (b) Magnified (111) diffraction peaks.

The growth conditions of 1 Pa total pressure and 11 sccm O<sub>2</sub> flow rate, have been used to grow Cu<sub>2</sub>O seed layers with 60, 120 and 400 nm thickness. 200 nm NiO layers with the growth conditions of 0.5 Pa total pressure and 11 sccm O<sub>2</sub> have been deposited on the top of these Cu<sub>2</sub>O seed layers. As shown in Fig. S1, all Cu<sub>2</sub>O seed layers can promote the <111> oriented NiO. Thicker seed layer is required to get a better crystallization of the NiO layer.

## 2. Influence of air-exposed Cu<sub>2</sub>O seed layer surface on the preferred orientation of NiO

The influence of air-contaminated Cu<sub>2</sub>O seed layer on the growth orientation of NiO has been investigated. A <111> oriented Cu<sub>2</sub>O layer with 360 nm was grown first, then the sputtering chamber was opened and the Cu<sub>2</sub>O surface was exposed to air atmosphere for one hour. Later, the sputtering chamber was closed leaving plenty of time for surface hydroxydation and pumped to 10<sup>-4</sup> Pa again. Subsequently, the NiO layer (200 nm) was grown on the air-exposed Cu<sub>2</sub>O seed layer without any plasma cleaning. X-ray diffractogram shows that the NiO in this bilayer thin film still has the <111> preferred orientation (see Fig. S2), which indicates that contamination of Cu<sub>2</sub>O seed layer in air is not able to prevent the growth of <111> oriented NiO.

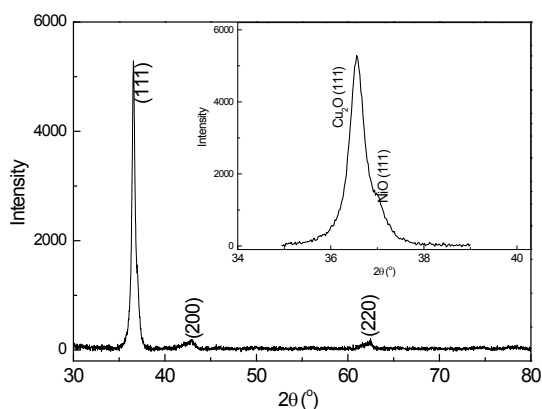


Fig. S2: X-ray diffractogram of 200 nm NiO film deposited on air-exposed Cu<sub>2</sub>O.