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Article

Correlation between the Dimensions and Piezoelectric Properties of ZnO Nanowires Grown by PLI-MOCVD with Different Flow Rates

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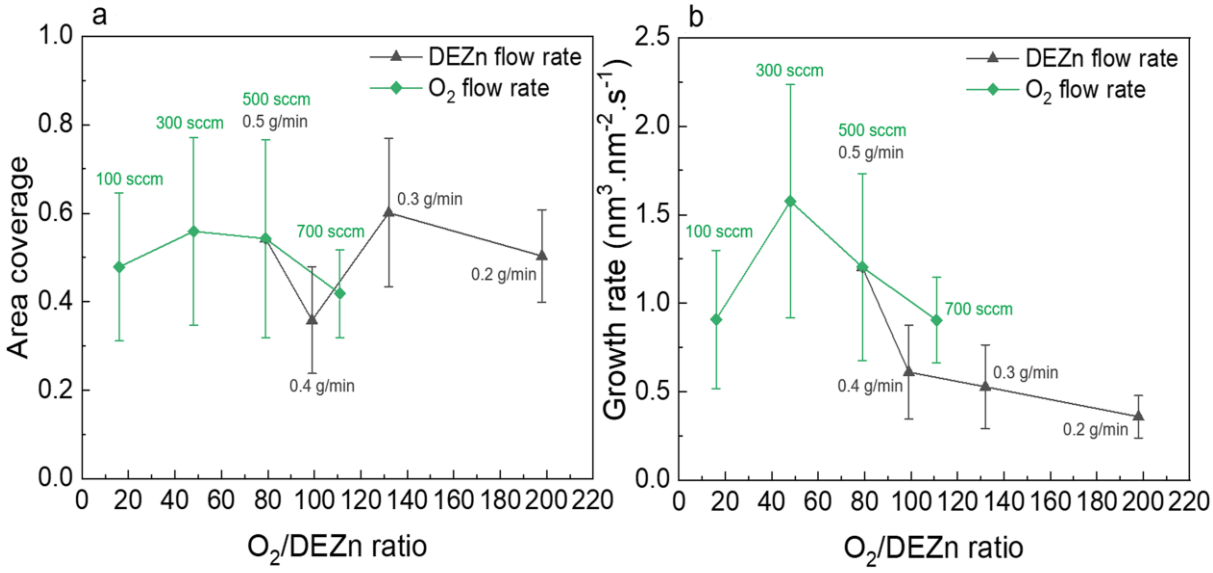

Figure S1. Evolution of (**a**) the coverage area and (**b**) the growth rate (volume per nm^2/s, or $nm^3.nm^{-2}.s^{-1}$) of NW arrays as a function of the O_2/DEZn flow rate ratio.

To simplify, we assume the NW section as being a cylindrical shape, then the growth rate can be calculated as follows:

$$growth\ rate_{(\text{volume per nm}^2\ /\ \text{growth } time)} = \frac{l \times \pi r^2 \times density}{t} \quad \text{(S1)}$$

where l is the NW length, r is the NW radius (half of diameter), t is the growth time, and density is the number of NW per nm^2 (the unit of density is converted from NWs/cm^2 to NWs/nm^2 for this calculation). In this equation, (πr^2 × density) is the defined as the area coverage of the NW array:

$$Area\ coverage = \pi r^2 \times density \quad \text{(S2)}$$

In other words, the area coverage is the total area of NWs per nm². Since there are voids between NWs, the area coverage values of NW samples are less than 1. In case of the thin film, the area coverage value is equal to 1 as there is no void, hence the equation (S1) becomes the film thickness/growth time ratio and is equivalent to the growth rate for a 2D layer.

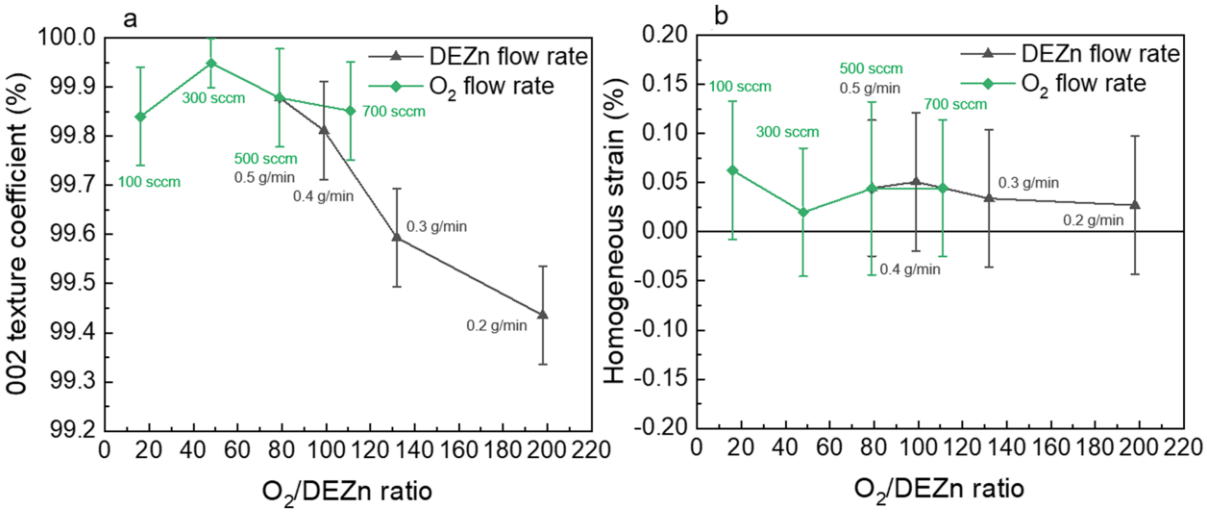

Figure S2. Evolution of (**a**) the 002 texture coefficients and (**b**) the residual homogeneous strains of NW arrays as a function of the O_2/DEZn flow rate ratio.

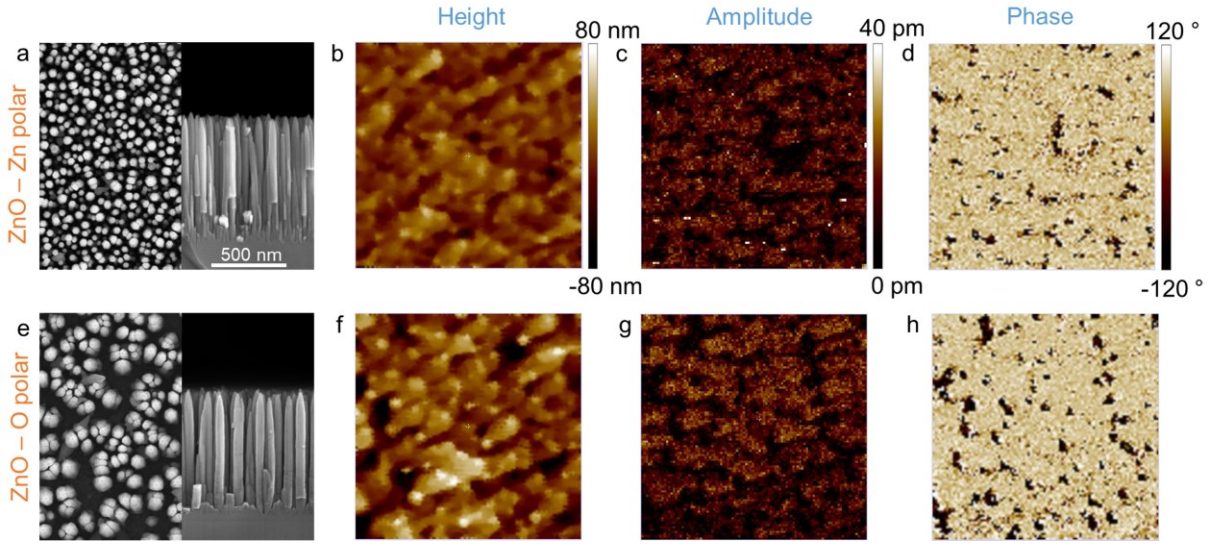

Figure S3. Top-view (**left**) and cross-sectional-view (**right**) FESEM images of ZnO NW arrays grown on (**a**) Zn-, and (**e**) O-polar ZnO substrates. PFM scanning images of ZnO NW arrays grown on (**b–d**) Zn-, and (**f–h**) O-polar ZnO substrates.

Figure S3 presents the FESEM images and PFM maps of ZnO NW arrays on ZnO substrates after the growth for 7 minutes. The FESEM images (Figures S3a and e) display the well-aligned ZnO NW arrays formed on the Zn- and O-polar ZnO substrates. The NW length is similar between the two arrays and around 870 nm. However, it can be seen that the NWs grown on the Zn-polar ZnO substrate have a smaller diameter and a higher density as compared to the NWs grown on the O-polar ZnO substrate. In detail, the diameters of NWs on the Zn- and O-polar ZnO substrates are around 49 and 53 nm, re-

spectively. The density of NW array on the Zn-polar ZnO substrate is around 25×10^9 NWs/cm^2, while it is 12×10^9 NWs/cm^2 on the O-polar ZnO substrate.