Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information

Gas phase fabrication of morphology morphology-controlled ITO nanoparticles and their assembled conductive films

Yilun Jiang, Ji'an Chen, Zhengyang Du, Fei Liu, Yuyuan Qin, Peng Mao* and Min Han*

Supplementary Note 1: The method for the specific resistance

At room temperature, the I-V characteristic of the thick ITO nanoparticle film is quite linear so that the resistance R_0 of the film can be extracted from the slope of the linear fit of the I–V curve. To estimate the specific resistance, we considering the real geometry of the ITO nanoparticle films that deposited on the IDEs substrates as follows:

According to the schematic diagram of the interdigital electrodes (IDEs) illustrated in Figure. S1(a), current flows from one electrode to another through various nanoparticle stripes that fill the gaps of the IDES. A schematic diagram of one such strip is shown in Figure. S1(b). For each strip, current conduction is addressed with a conduction length corresponding to the inter-electrode distance, that means the length L of the strip, with a conduction cross section of $t \cdot w$, where t is the thickness of the nanoparticle stripe, and w is the length of the nanoparticle stripe. Totally, the conductance between the whole electrodes is contributed with all the nanoparticle strips, that means the total conduction cross section between the electrodes is equal to $t \cdot w \cdot N$, where N is the number of stripes. The specific resistance of the nanoparticle film at room temperature is then estimated as: $\rho_0 = R_0 \cdot t \cdot w \cdot N / L$. In the present study, the inter-electrode distance is 20 µm, and covering the IDEs totally 120 nanoparticle strips are composed.

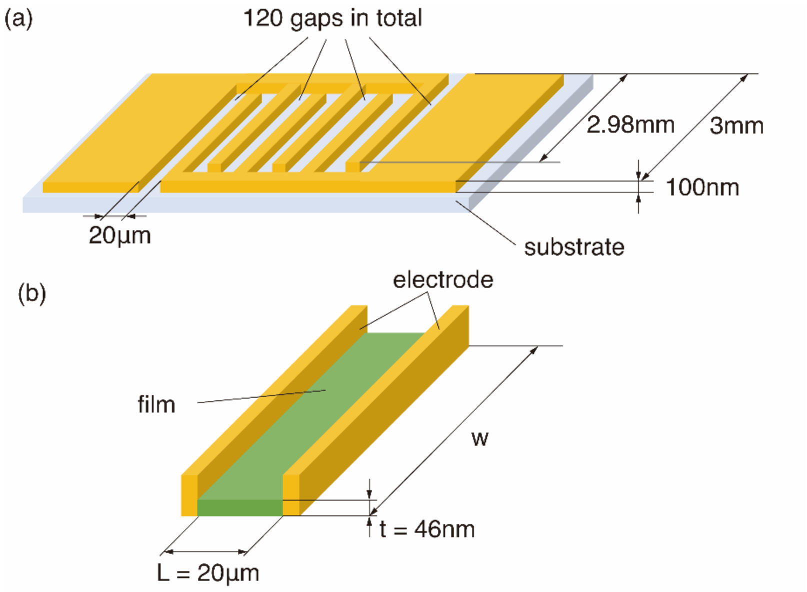

Figure S1. Schematic diagram of the interdigital electrodes (a) and a nanoparticle strips covering the electrode gap (b).

Supplementary Note 2: Definition of the nanoparticle size and measuring method

Diameter definitions for individual rod-shaped nanoparticles and components are shown in Figure S2, where dashed lines represent cross-sectional areas. Line *a* represents the size of a single rod-shaped nanoparticle, i.e., the size of each assembly, while lines *b*, *c*, and *d* represent each size of the rod-shaped assembly, respectively. Lines *b*, *c*, and *d* all account for the size distribution of diffusion and growth that occurs after directional attachment, which reflects the final size of each major branch. It is defined because the long axis of the rod-like assembly cannot be measured. After all, one side edge of the rod disappears with the coalescence of the ITO nanoparticles. Objectively, it is more feasible to define the size of irregular nanoparticles by comprehensively considering the shape factors (such as aspect ratio) or the equivalent volume or area of each nanoparticle. However, due to the two-dimensional projected nature of TEM images, due to the large number of different orientations of nanoparticles, it is difficult to obtain a proper distribution of all branches correspondingly, which significantly affects the measurements of length, volume, and area. In contrast, the diameter of a branch can be considered to be direction-independent. Furthermore, all nanoparticles (both individual and rod-shaped particles and components) are measured against the same standard.

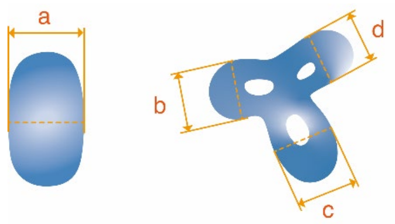

Figure S2. The sketch of the size measurement method of single rod-like ITO nanoparticles and components where the dotted line represents the adopted cross-sectional area. Line *a* represents the size of a single rod-like nanoparticle, while line *b*, *c* and *d* indicate each size of rod-like component, respectively.