Supplementary Material (ESI) for *Journal of Materials Chemistry*

Electronic Supplementary Information

Synthesis of aluminum-doped ZnO nanocrystals with controllable morphology and enhanced electrical conductivity

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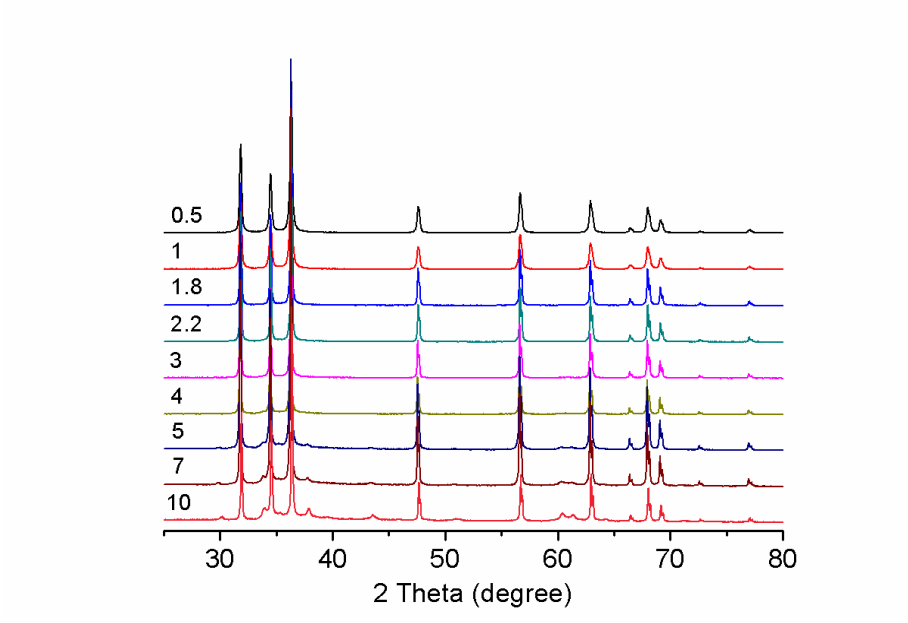

Fig. S1 Powder XRD patterns of AZONs synthesized by solvothermal method at 120 ºC for 12 h with different Al^{3+} concentration.

The detailed XRD peaks (Fig. S2) of AZONs show scattering angle of 31.819°, 34.466° and 36.190° from Fig.1, corresponding to crystal planes (100), (002) and (101) of ZnO, respectively. The results suggest that AZONs are in wurtzite form. Meanwhile, the average crystallite size estimated by Scherrer equation is about 44.3 nm, 41.3 nm, 39.4 nm and 41.8 nm, similar with those observed from the TEM.

Scherrer equation: $d = 0.89\lambda/(B\cos\theta)$

Where d, λ, B and θ are the grain size, X-ray wavelength, the full-width-at-half-maximum, and Bragg angle, respectively.

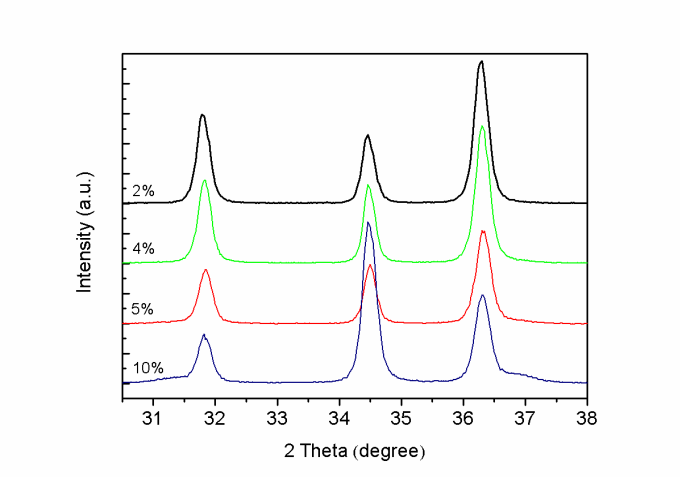

Fig. S2 Powder XRD patterns of the AZONs calcined under H_2 atmosphere for 2 h at 700 ºC.

Along with the increase of reaction time, the mean size of AZONs (2%) increased gradually. The grain size is estimated to be ca. 11.8 nm (10 min), 28.2 nm (4 h), 40.9 nm (8 h) and 44.8 nm (12 h) using the Scherrer equation. This exhibits a similar tendency as obtained from the TEM, as shown in Fig. 3.

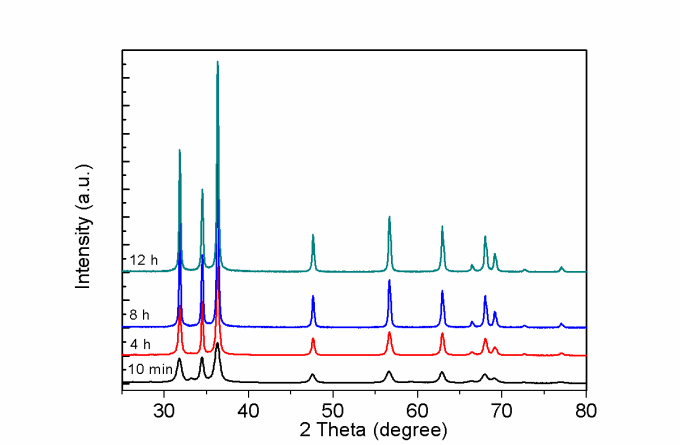

Fig. S3 XRD patterns of as-synthesized AZONs show structural phase evolution from amorphous gel to highly crystalline nanocrystals at different stages.

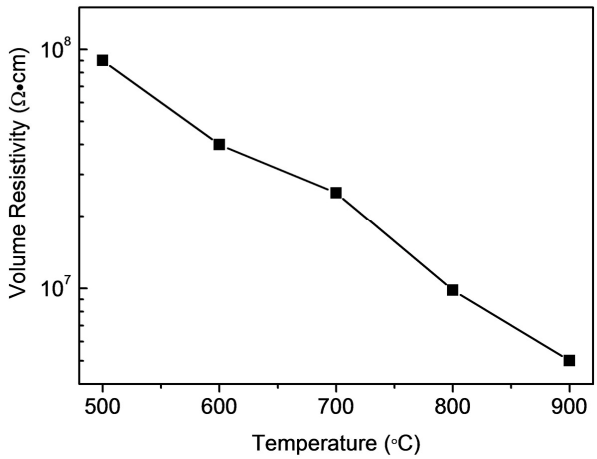

Fig. S4 Volume resistivity of pure zinc oxide nanoparticles versus calcination temperature. Here, the samples are prepared by calcining ZnO nanocrystals from 500 ºC to 900 ºC for 2 h under H_2 atmosphere.

Volume resistivity of AZONs (2%) calcined from 200 ºC to 850 ºC for 2 h is shown in Fig. S5, indicating that the resistivity decreases with the temperature increasing. From the SEM images of Fig. 8, we believe that the calcination temperature should be controlled within 700 ºC. Besides, the dependence of volume resistivity on calcining time is also studied. We carried out the calcination procedure at 700 ºC for 0.5–10 h under H_2 atmosphere, and the results are shown in Fig. S6. The volume resistivity decreases rapidly up to 2 h as the incorporation of impurities are formed at the temperature as high as 700 ºC then. Afterwards, the decline rate becomes very small for longer calcining time.

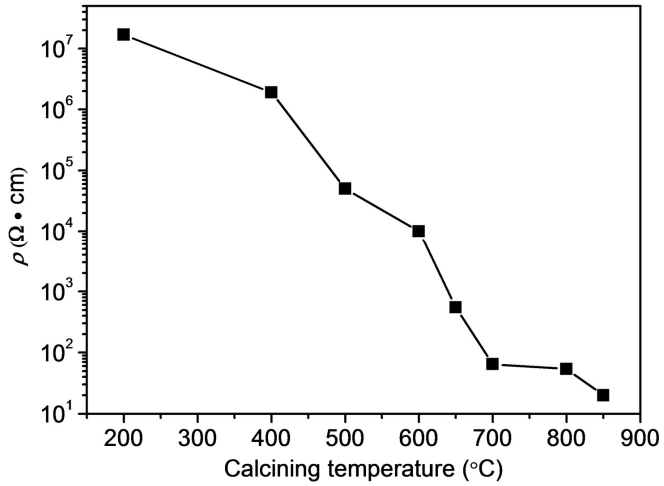

Fig. S5 Volume resistivity of AZONs (2%) versus the calcination temperature. Here, the samples are calcined from 200 ºC to 850 ºC for 2 h under H_2 atmosphere.

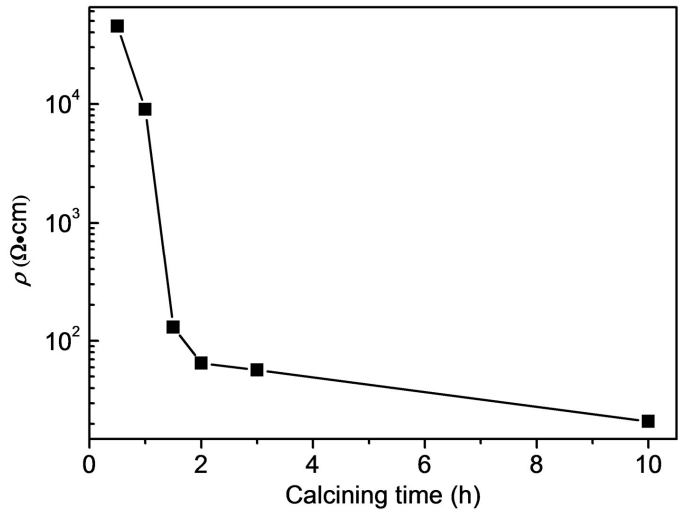

Fig. S6 Volume resistivity of AZONs (2%) versus the calcining time. Here, the samples are calcined at 700 ºC from 0.5 h to 10 h under H_2 atmosphere.