Figure S1

XRD patterns of 5 independent ZnO powders without mechanical treatment (raw ZnO) in order to estimate the standard deviations of X-ray diffraction patterns. The deviation of each peak was calculated to be 0.024 to 0.028.
Figure S2

Diffraction degree $2\theta$ of (100), (002) and (101) of ZnO treated using (a) mechanical milling and (b) stirred media milling techniques as a function of mixing time. For the stirred media milling, ZnO powders were milled under wet condition using ethanol as a solvent and ZrO$_2$ particles of approximately 1 mm in diameter as mixing agent.
Figure S3

XRD patterns of ZnO powders for (101) peak (a) after Turbula-shaking and (b) after planetary-ball milling. ZnO indicates before shaking. The numbers inside graph indicate FWHM (deg).
Figure S4

(a) TEM image of sulfur-doped ZnO particles, and (b) Particle size distribution histogram of sulfur-doped ZnO calculated using 50 particles. The histogram is normalized and the integral of the distribution function is equal to 1.
Figure S5 (a) Raman spectra of ZnO particles and (b) normalized Raman intensity as a function of mixing time using ethanol as solvent. The $D$, $\Delta$ and $c_0$ were estimated to be $1.4 \times 10^{-20}$ m$^2$/s, 1 nm and 1.12, respectively. The $c_0$ increases significantly compared with dry condition. Ethanol shows reducing character, and oxygen extract from ZnO surface (formation of $V_o$) may occur easily, leading to increase $c_0$ under ethanol (wet) atmosphere.

Figure S6 Normalized Raman intensity as a function of square root of mixing time using ethanol, pentanol and water as solvents. From the slope, the $V_o$ formation rate increases in the order of $H_2O <$ Pentanol $<$ Ethanol, suggesting the formation of $V_o$ proceeds easily by increasing the reductively of solvent.