Electronic Supplementary Materials

Unexpected gas sensing property of SiO_2/SnO_2 core-shell nanofibers in dry and humid conditions

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Supplemental Data 1

FT-IR spectra were measured by an FT-IR spectrometer equipped with an ATR accessory (Spectrum Two, Perkin Elmer) (Fig. S1). There is the broad peak between 700 and 400 cm^{-1} derived from typical SnO_2 absorption [1] each in the SiO_2/SnO_2 nanofibers and the SnO_2 nanoparticles, besides the peaks derived from amorphous SiO_2 [2] and Si–O–Sn bond [3] in the SiO_2/SnO_2 nanofibers.

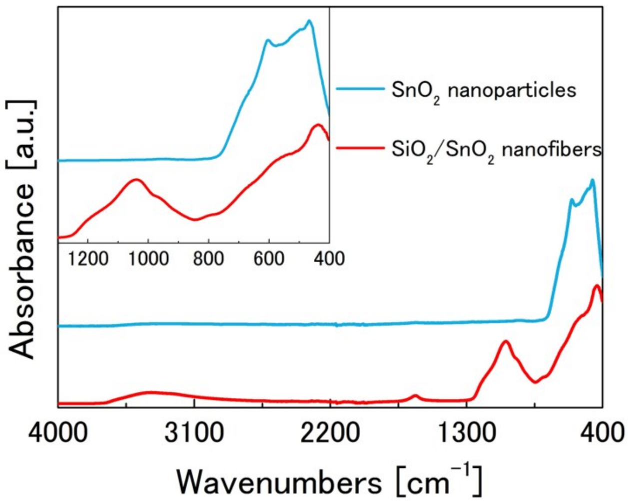

Fig. S1 FT-IR spectra of SiO_2/SnO_2 nanofibers and SnO_2 nanoparticles.

Supplemental Data 2

X-ray photoelectron spectroscopy (XPS) measurements were performed on an XPS microprobe spectrometer (PHI 5000 Versa Probe II, Ulvac-Phi). All XPS spectra were calibrated using a C 1s peak which is assumed at 284.8 eV [4]. As a reference material, commercial SnO_2 nanoparticles with rutile phase (Sigma-Aldrich) were also measured. In the XPS spectra of the SiO_2/SnO_2 nanofibers, the chemical shifts in binding energy of Sn 3d were observed depending on the presence of SiO_2. It is speculated that these shifts were derived from the Si–O–Sn bond as reported in the system of SnO_2 thin film deposited on SiO_2 substrate [5].

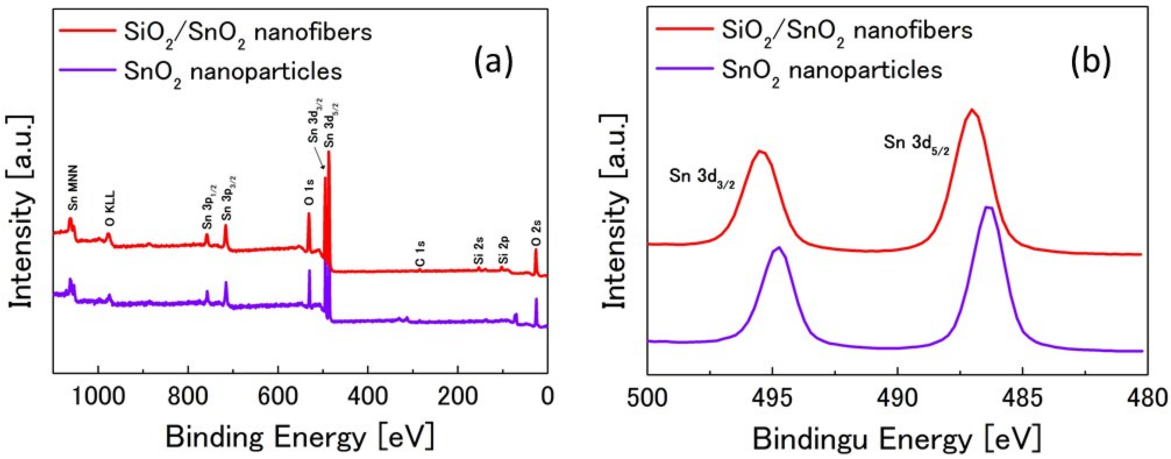

Fig. S2 XPS patterns of SiO_2/SnO_2 nanofibers and SnO_2 nanoparticles; (a) Survey spectra and (b) high resolution spectra for Sn 3d.

Supplemental Data 3

Zeta potential measurements were carried out with a zeta potential analyzer (ELSZ-2Plus, Otsuka Electronics). As reference materials, commercial SnO_2 nanoparticles with rutile phase (Sigma-Aldrich) and commercial amorphous SiO_2 nanoparticles (Sigma-Aldrich) were also measured. Although the SnO_2 nanoparticles showed the isoelectric between 4 and 5, the SiO_2/SnO_2 nanofibers showed the behavior as same as the SiO_2 nanoparticles. Hence, it seemed that SiO_2 in the SiO_2/SnO_2 nanofibers partially exposed at the surface in analogy with the SiO_2/TiO_2 nanofibers previously reported [6].

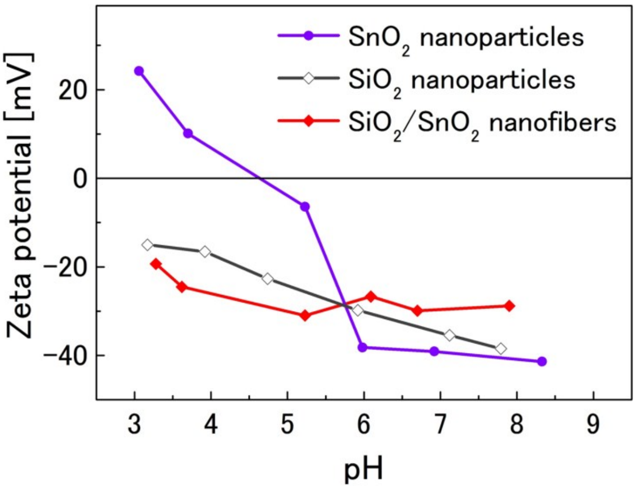

Fig. S3 Zeta potential of SnO_2 nanoparticles, SiO_2 nanoparticles, and SiO_2/SnO_2 nanofibers at various pH values.

Supplemental Data 4

Electric resistance changes under introduction of air containing 200 ppm H_2 or CO at various temperatures between 300 and 450°C in dry condition.

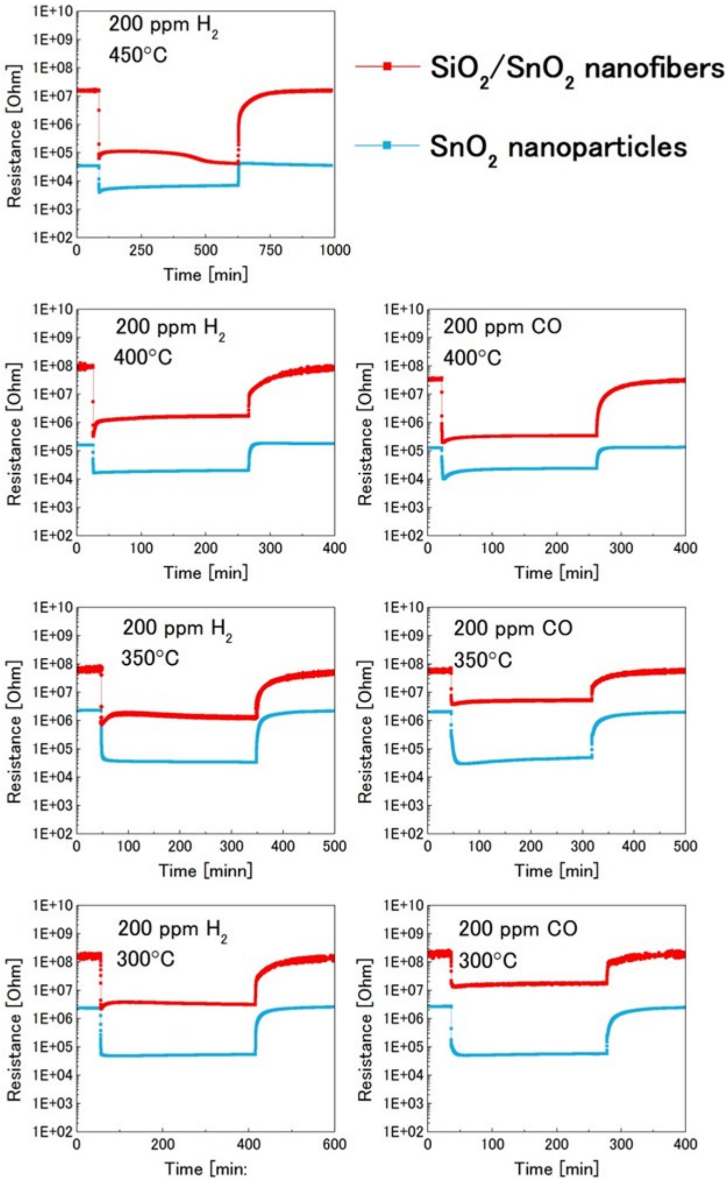

Fig. S4 Electric resistance changes under introduction of H_2 or CO at various temperatures in dry condition.

Supplemental Data 5

Electric resistance changes under introduction of air containing 200 ppm H_2 or CO at 400°C or 450°C in humid condition containing up to 3 vol% water vapor.

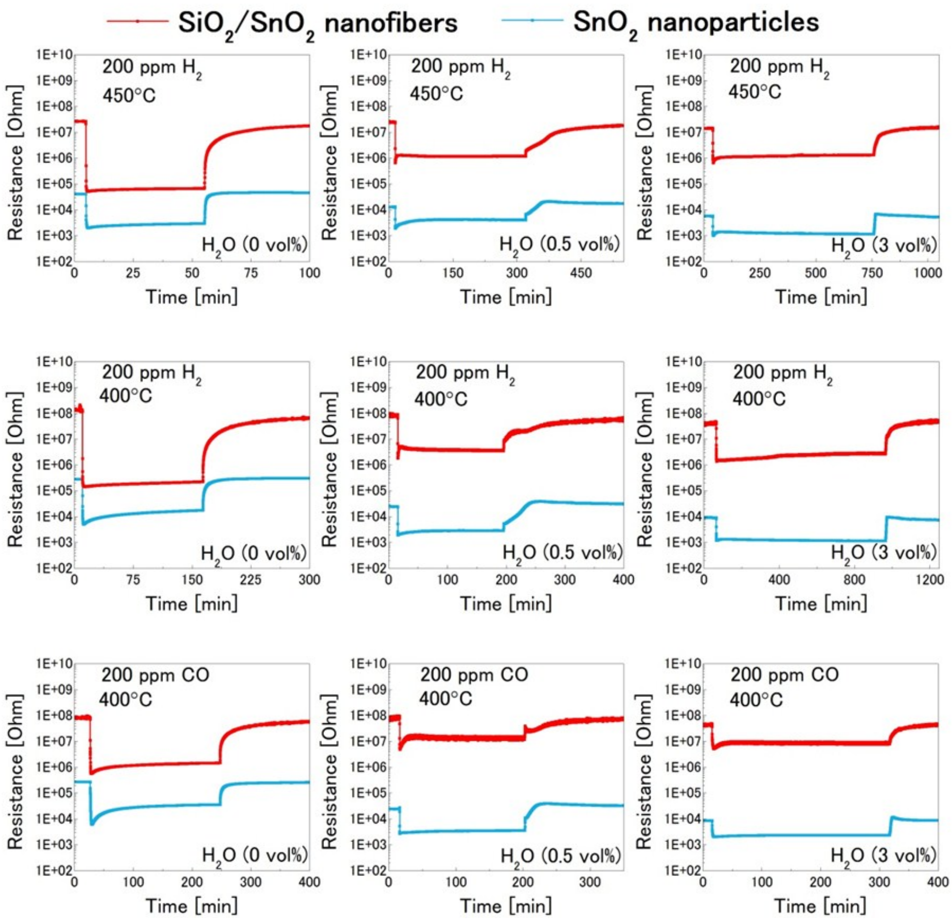

Fig. S5 Electric resistance changes under introduction of H_2 or CO at various temperatures and various humidities.

References

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