

## Supplementary Materials

### **Redox Activity and Chemical Interaction of Metal Oxide Nano- and Micro- Particles with Dithiothreitol (DTT)**

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## Results and Discussion

**Particle size distribution:** Particle diameters of the tested commercial MOs (CuO, MnO<sub>2</sub>, ZnO, PbO, Pb<sub>3</sub>O<sub>4</sub> and Cr<sub>2</sub>O<sub>3</sub>) were measured using SEM. Samples of SEM images of ZnO and Pb<sub>3</sub>O<sub>4</sub> are shown in Figure S1. Diameters of 100 mineral oxide particles (100 for each of the 6 different metal oxides) are shown in Table S1.

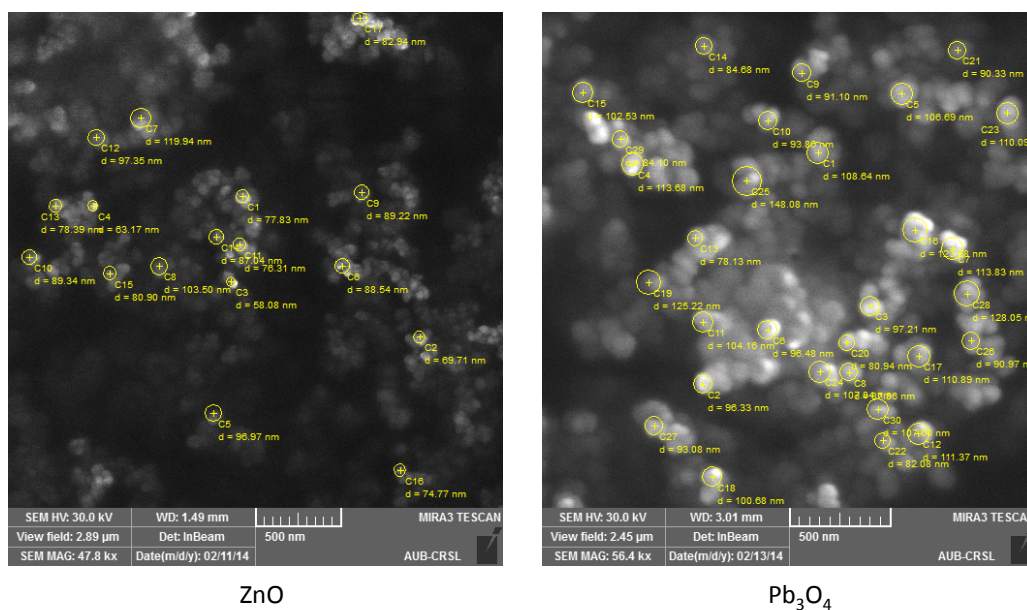


Figure S1 SEM sample images of ZnO and Pb<sub>3</sub>O<sub>4</sub> dispersed particles characterized by averaging the diameters of 100 particles

Table S1 Average diameters (nm) of 100 particles of the six different metal oxides that were tested for their reactivity against Dithiothreitol (DTT)

Metal Oxide	Average Diameter (nm)	Standard Deviation
CuO	67.8	5.1
MnO <sub>2</sub>	96.2	6.7
ZnO	78.4	9.1
PbO	87.3	7.1
Pb <sub>3</sub> O <sub>4</sub>	76.3	6.4
Cr <sub>2</sub> O <sub>3</sub>	69.3	6.6
<b>Average</b>	<b>79.22</b>	<b>6.83</b>

*DTT redox activity:* SEM images and EDX spectra, taken before (A) and after adding DTT solutions (B) to suspended CuO in methanol. Image (B) shows the presence of sulfur atom at the surface of the CuO after reacting with DTT (Figure S2).

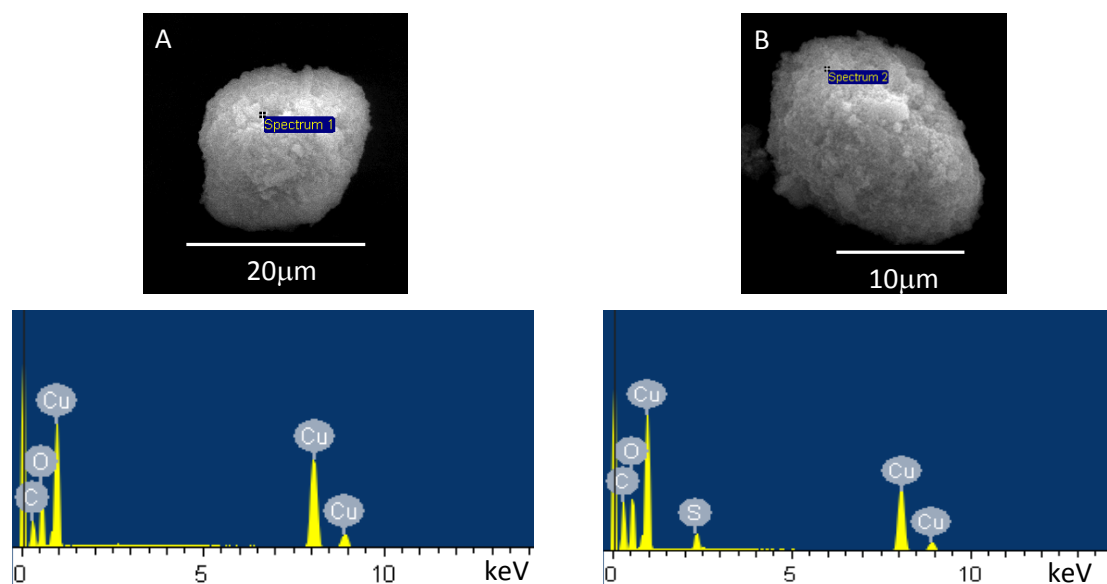


Figure S2 SEM Images and EDX spectra of CuO particle taken before (A) and after the addition of DTT solutions (B) to suspended CuO in methanol

Table S2 EDX analysis of the particle surface at the point indicated in Figure S2

Element	Before adding DTT		After adding DTT	
	Weight %	Atomic %	Weight %	Atomic %
C K	34.91	53.59	43.56	58.68
O K	31.91	36.78	35.15	35.55
Cu K	33.18	9.63	19.91	5.07
S K			1.39	0.70

Table S3. Assignments of the Infra red frequencies for the DTT and oxidized DTT spectra

Wavenumber (cm <sup>-1</sup> )	DTT	Oxidized DTT
677	$\nu(\text{C-S})$ stretch	
746 and 756		$\nu(\text{C-S})$ stretch of the <i>Gauche</i> and <i>Trans</i> forms around the C-C bonds
791		$\nu(\text{CH}_2)$ rocking attached to disulfide
994, 1008, and 1036		$\nu(\text{C-C})$ vibrations with an enhanced and sharp <i>Trans</i> $\nu(\text{C-C})$ band at 1036 cm <sup>-1</sup>
1054 and 1101	$\nu(\text{C-O})$ stretch	
1060		$\nu(\text{C-O})$ stretch
1100 and 1375		$\nu(\text{CH}_2)$ twisting-rocking and wagging bands
1230 and 1320	$\nu(\text{CH}_2)$ deformation	
1408	$\nu(\text{CH}_2)$ scissoring	
1453		$\nu(\text{CH}_2)$ sharp; scissoring typical of disulfide DTT adsorbed on metal surfaces
2547 and 2564	$\nu(\text{S-H})$ stretch	
2873, 2909, 2930 and 2956		$\nu(\text{CH}_2)$ asymmetric and symmetric stretch
2910 and 2970	$\nu(\text{C-H})$ stretch	
3303		$\nu(\text{OH})$ intra-molecularly bond
3360	$\nu(\text{OH})$ hydrogen bond with methanol (solvent)	
3430		$\nu(\text{OH})$ un-bonded