Supporting Information

Single-Crystal like Mesoporous ZnO:Mn^{2+} Nanorings of High Optoelectronic Quality Formed by Self-assembly of Nanoparticles in Ultrasonic Hydrolysis Process

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1. Characterization of the ZnO:Mn^{2+} nanostructures:

For X-ray diffraction of the powder samples a Rigaku X-ray diffractometer with Cu Kα (λ = 1.5406 Å) radiation, operating at 40 keV was used. For morphology and structural characterization of the samples a JEOL, JEM 2100F field emission transmission electron microscope (FETEM) attached with 2k X 2k Charge Coupled Device, scanning transmission electron microscopy, and energy dispersive spectroscopy system was utilized. For TEM observations, the powder samples were dispersed in ethanol, spread over carbon coated microscopic grids, and dried under an infrared lamp. An X-ray photoelectron spectroscopy system (MultiLab2000, THERMO VG SCIENTIFIC) with MgK□ radiation source was utilized for the composition and chemical state analysis of the samples. Estimation of average pore size and specific surface area of the porous samples were performed through their nitrogen adsorption-desorption behaviours utilizing an automated QUADRASORB 'SI' analyzer of Quantachrome Instruments. For magnetic measurements a Quantum Design MPMS SQUID VSM dc Magnetometer operating either at room temperature or at 10K was utilized. Electron spin resonance spectra of the samples were recorded utilizing a JEOL JEXPS 2300 Fourier transform electron spin resonance magnetometer. Room temperature PL measurement of the samples was performed using a the 325 nm emission of a He-Cd laser (Melles-Griot) as

excitation source, a 1 meter long Science Tech monochromator, and a Hamamatsu photomultiplier as detector. For obtaining Raman spectra, an OLYMPUS BX41 microRaman system of Horiba JobinIvon, fitted with a He-Ne (λ=332.6 nm) laser as excitation source and a thermoelectrically cooled (-68.0 ^{0}C) charged couple device as detector.

2. TEM and HRTEM images:

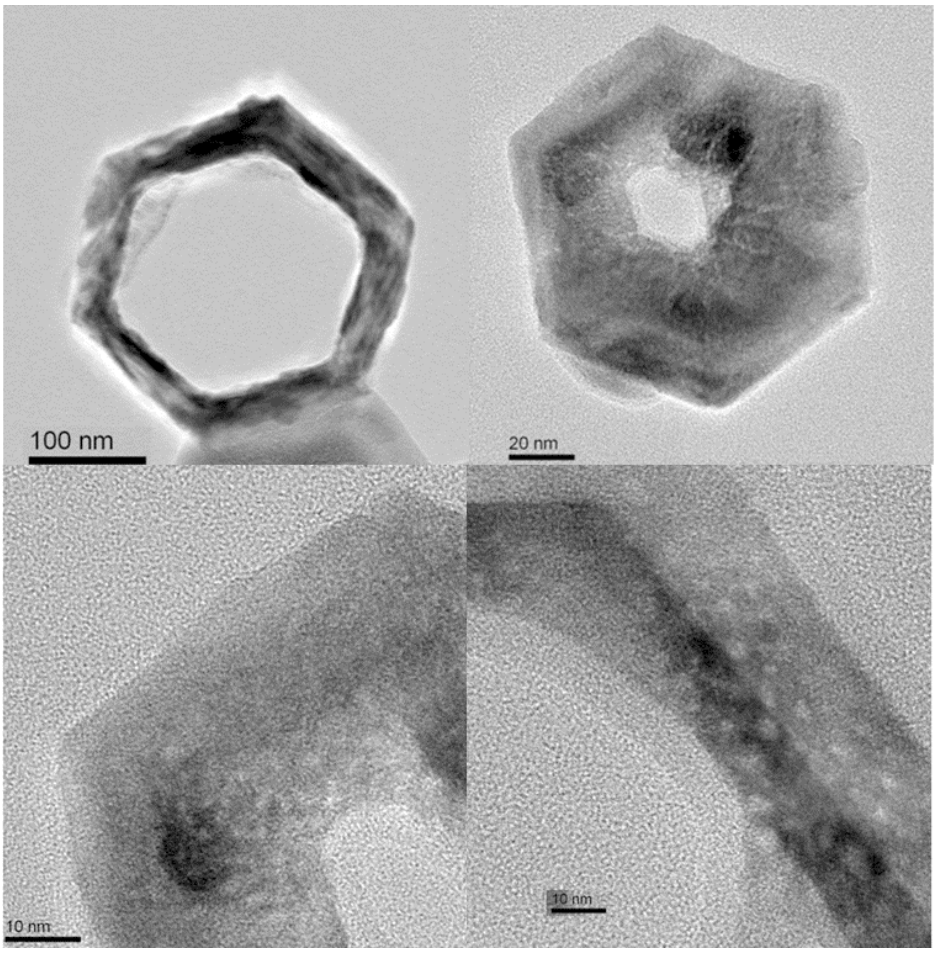

Figure 1S. Typical TEM and HRTEM images of the porous ZnO:Mn^{2+} nanoring structures.

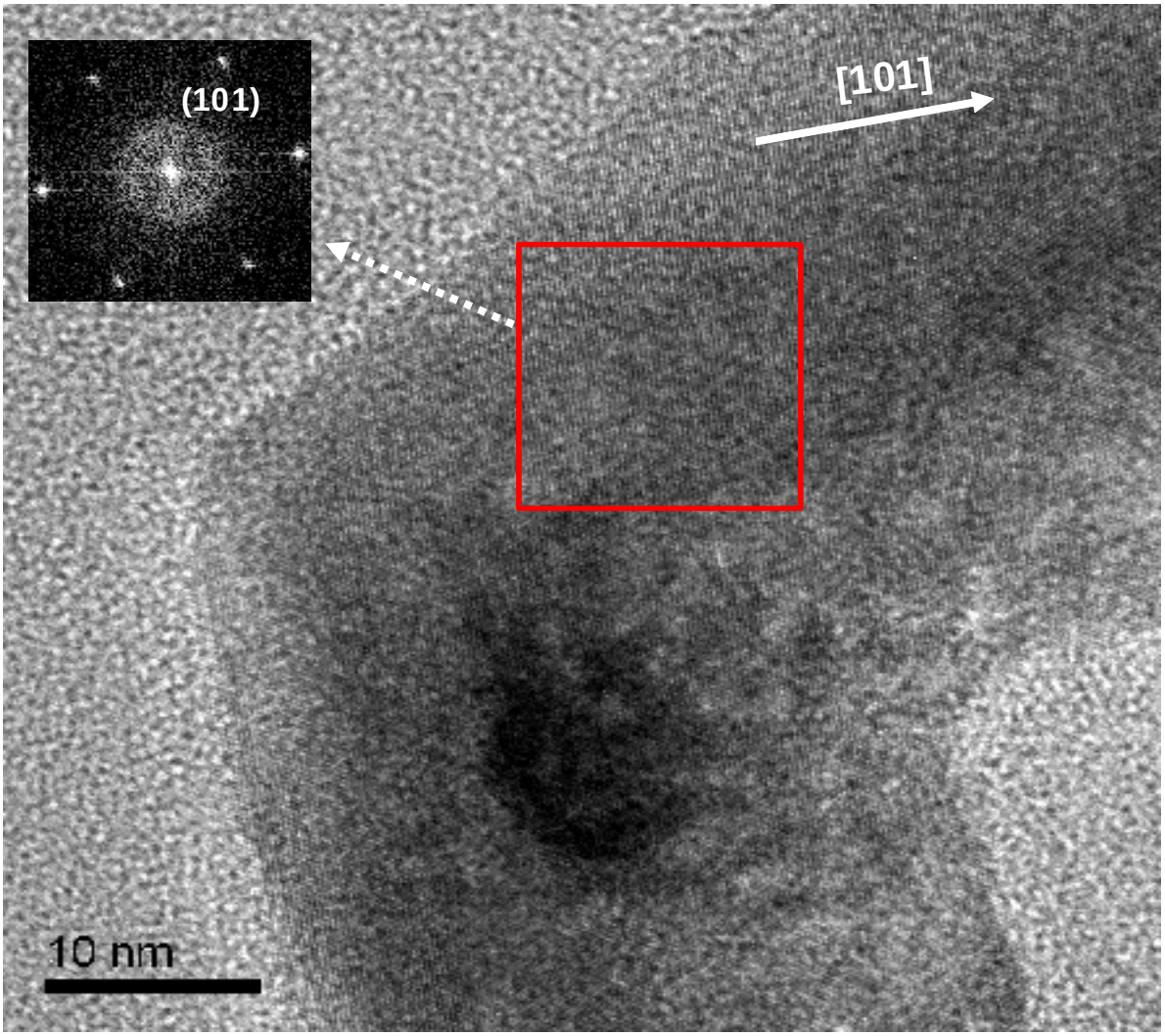

Figure 2S. High resolution TEM image of a part of a ZnO:Mn^{2+} nanoring structure, and fast Fourier transform (FFT, inset) of a selected area, showing its single-crystal nature.

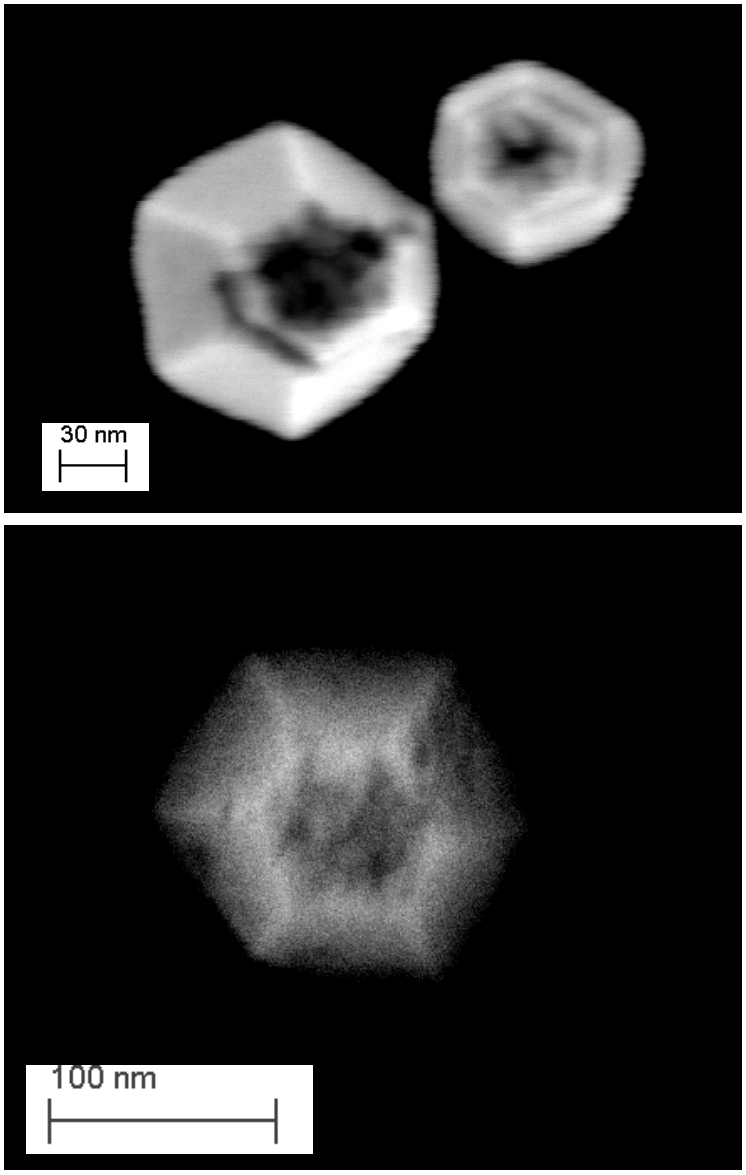

Figure 3S. Typical SEM images of the nanoring structures.

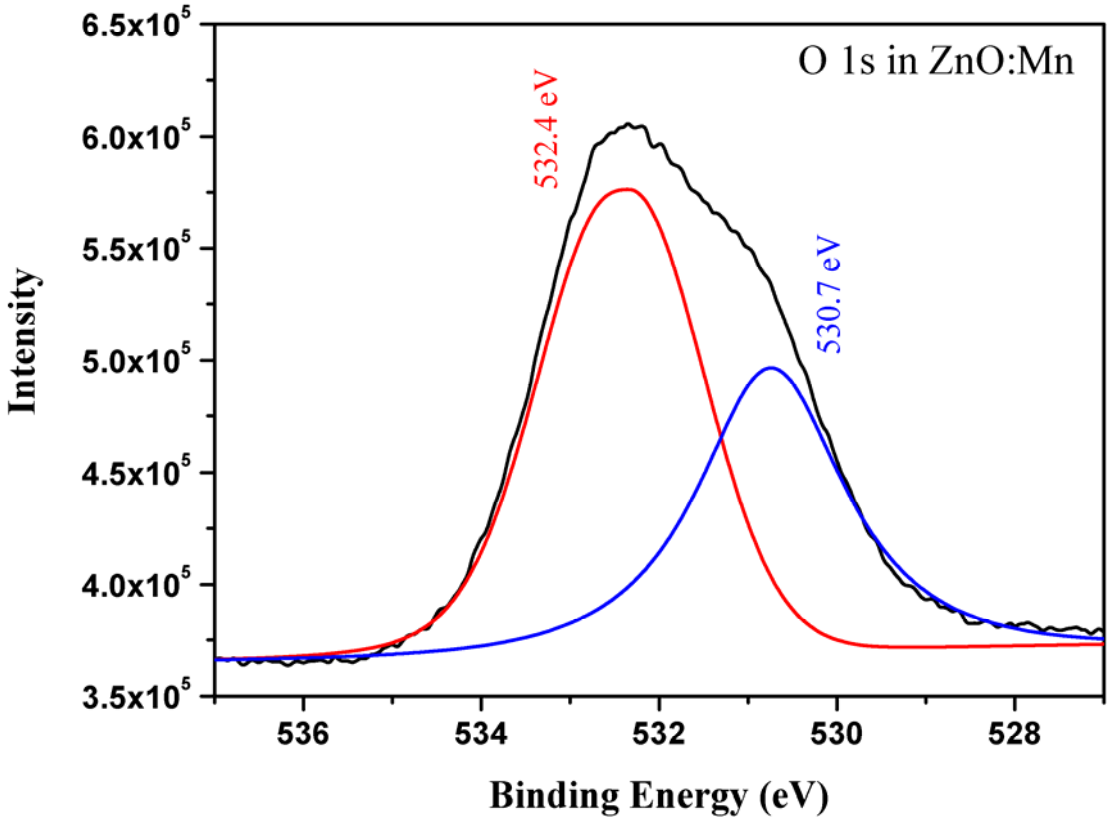

Figure 4S. Deconvoluted XPS spectrum of O 1S state in ZnO:Mn nanostructures. While the 530.7 eV component is associated with the formation of ZnO, the 532.4 eV component is associated with the oxide of manganese.