ELECTRONIC SUPPORTING INFORMATION (ESI)

A general synthesis of metal (Mn, Fe, Co, Ni, Cu, Zn) oxide and silica nanoparticles based on a low temperature reduction/hydrolysis pathway

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All reagents for cell culture were purchased from Invitrogen, and other reagents were obtained from Sigma Aldrich, unless otherwise specified.

Cell culture

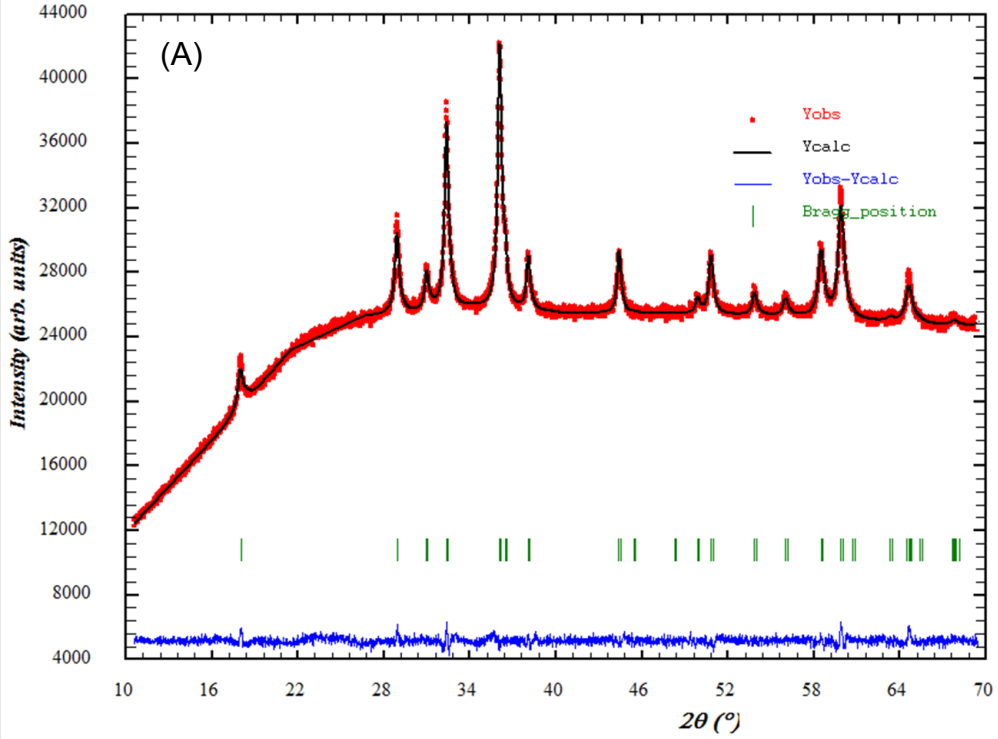
A human liver epithelial cell line (HepG2; American type tissue culture collection), a mouse brain endothelial cell line (bEnd.3; American type tissue culture collection); and a human intestine epithelial cell line (Caco2; American type tissue culture collection) were used as cell culture models for liver, brain and intestine, respectively. The HepG2 cells (passage number 10-30) were cultured in Dulbecco's modified Eagle's medium (DMEM, Hyclone) supplemented with 10% heat-inactivated Fetal Bovine Serum (FBS, Hyclone), 50 U/mL penicillin and streptomycin (MP Biomedicals) at 37 °C and 5% CO_2. Cells were expanded in T-75 tissue culture flasks, and then passed and seeded at 2×10^5 cells per well on 12 well and 6 well plates

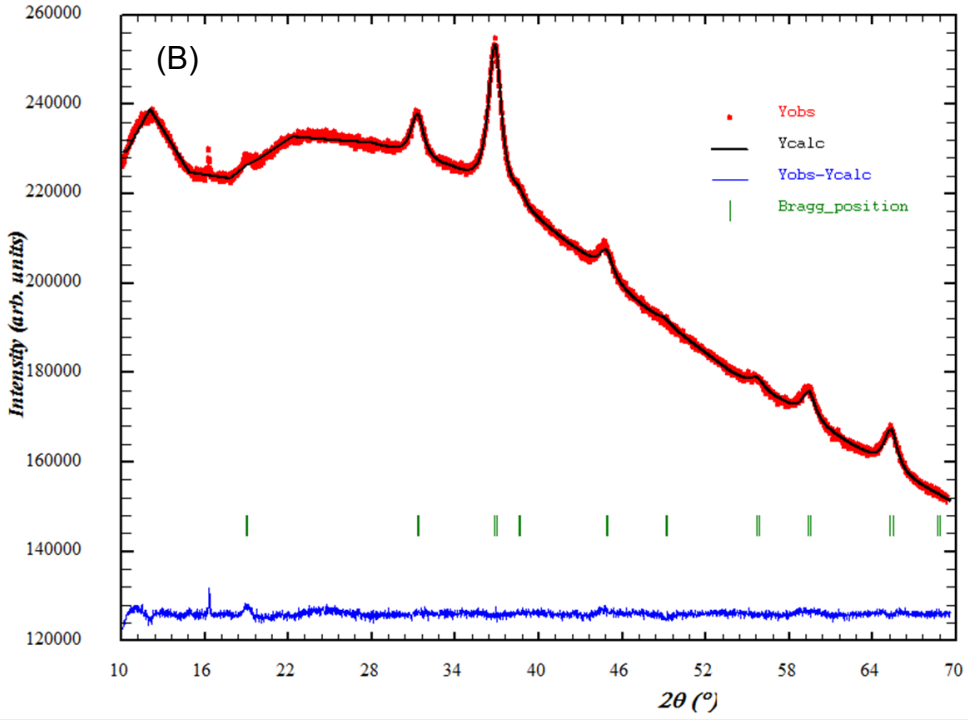
for cell viability and uptake studies, respectively. Culture medium was changed every two days. All experiments were performed on confluent monolayers typically at day 4 or 5, post seeding.

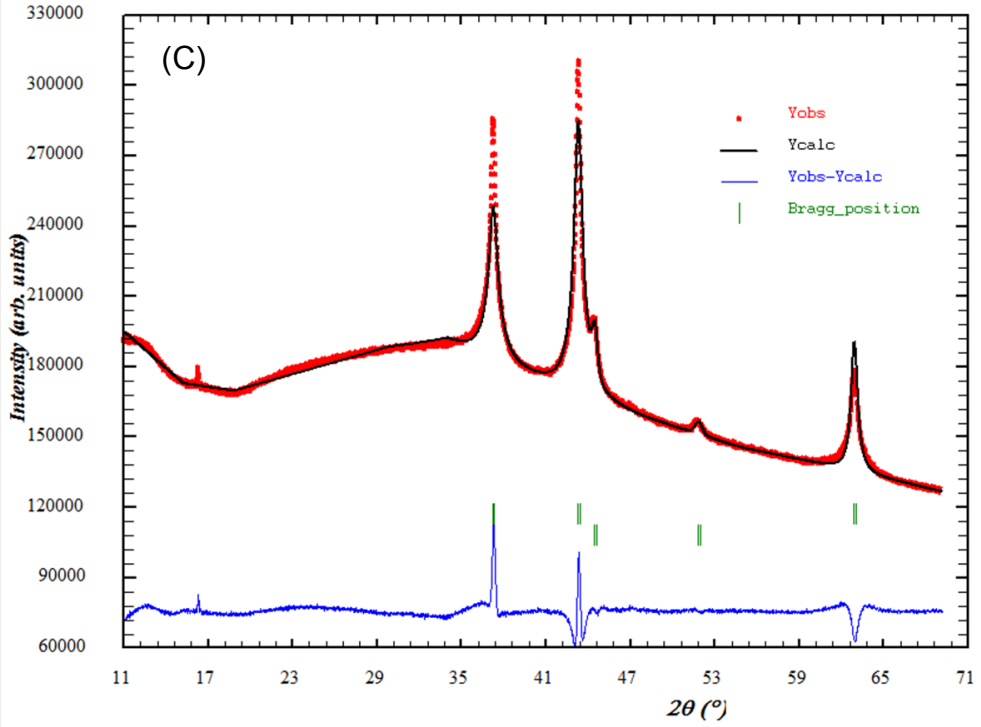
Cell viability studies

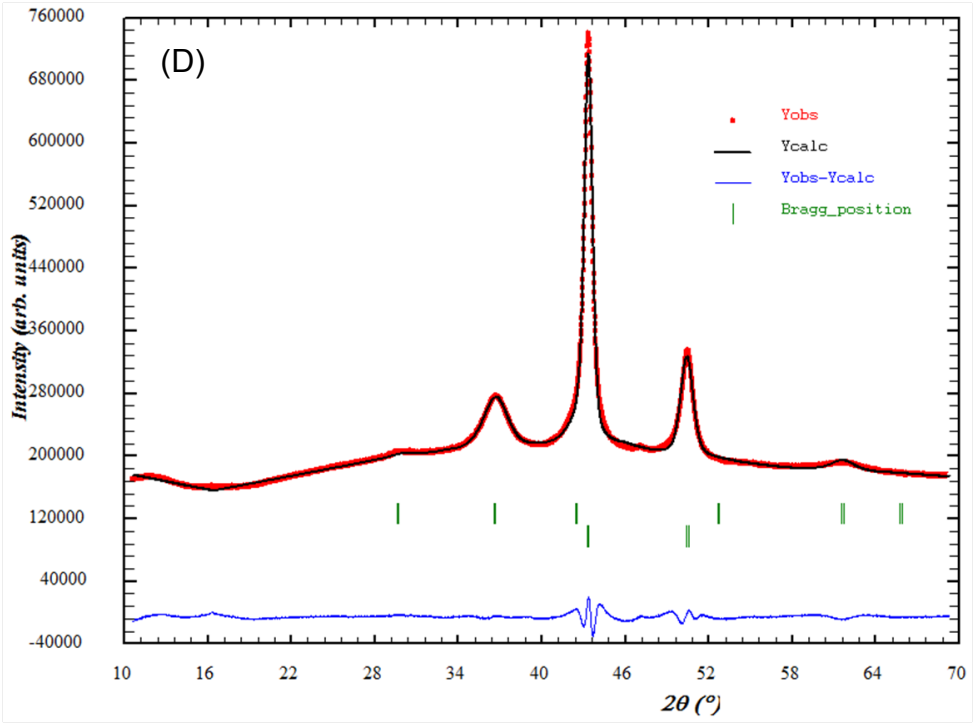
Cells grown to confluence in 12 well plates (Costar) were treated with various concentrations of Mn_3O_4-NPs and incubated for 24 hrs at 37 °C. To each well, 200 µL of 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT reagent), 5 mg/mL in Phosphate-Buffered Saline (PBS) was added and incubated for 3hrs at 37 °C. Then the PBS was removed, and the purple colored formazan crystals were dissolved by adding 1 mL of dimethylsulfoxide. The absorbance (A) at 567 nm was measured using a plate reader (Synergy HT, BioTek). The percentage cell viability of cells treated with various NP concentrations compared to control cells that just received DMEM was calculated by $(A_{sample}/A_{control}) \times 100$.

Figures:









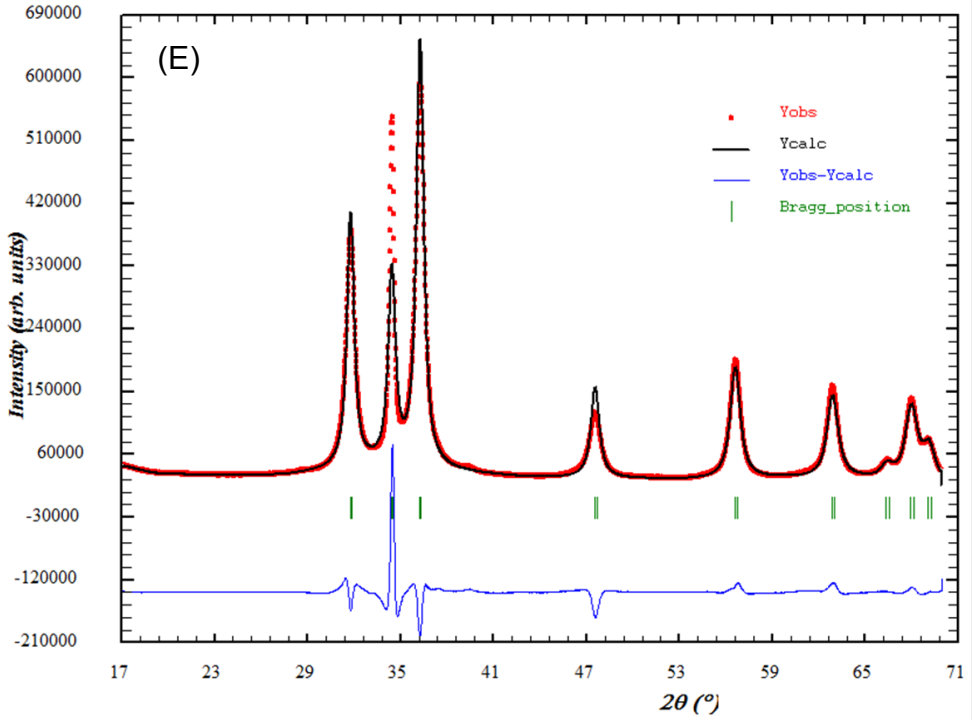


Figure S1: Rietveld plots for (A) Mn_3O_4-NP, (B) Co_3O_4-NP, (C) Ni/NiO-NP, (D) Cu/Cu_2O-NP, and (E) ZnO-NP. The dotted red line is the observed pattern and solid black line is the obtained fit. The difference spectrum is shown in blue and the calculated Bragg positions are shown as vertical lines.

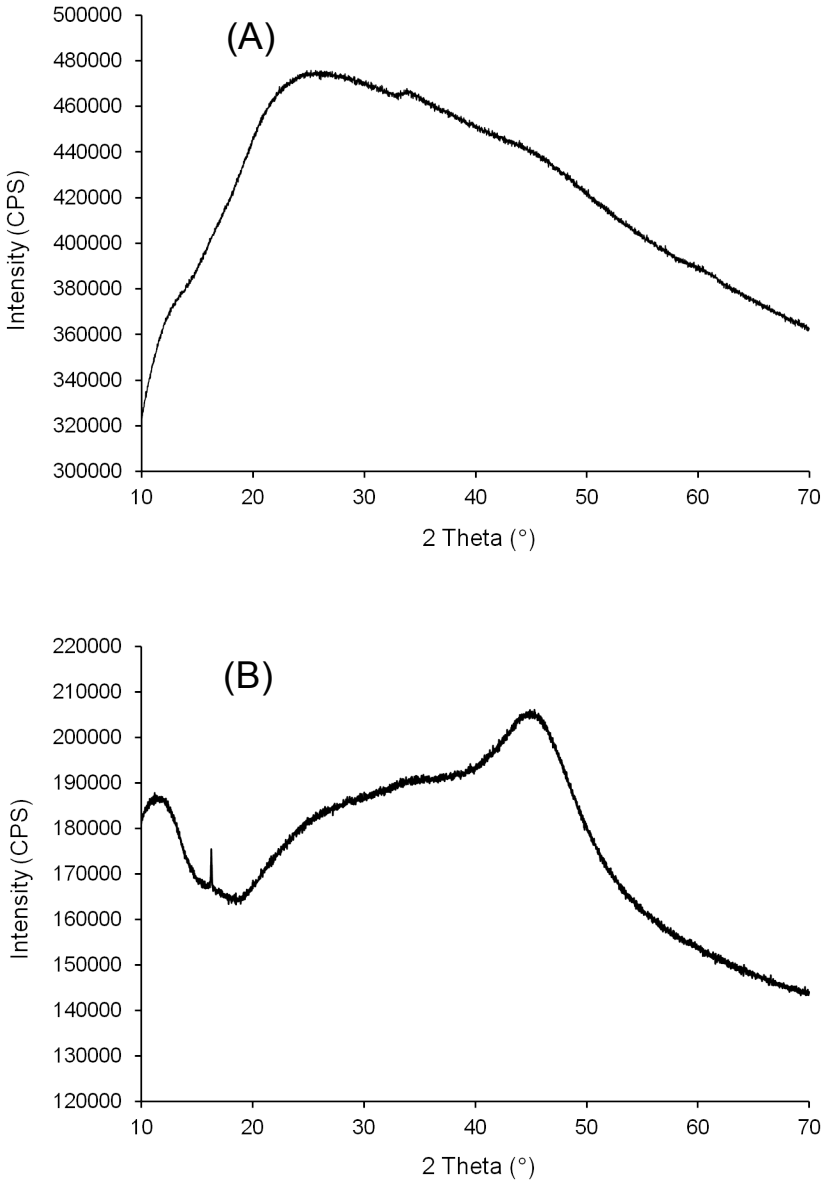


Figure S2: XRD pattern of (A) Co_3O_4-$NP_{precursor}$ and (B) Ni/NiO-$NP_{precursor}$.

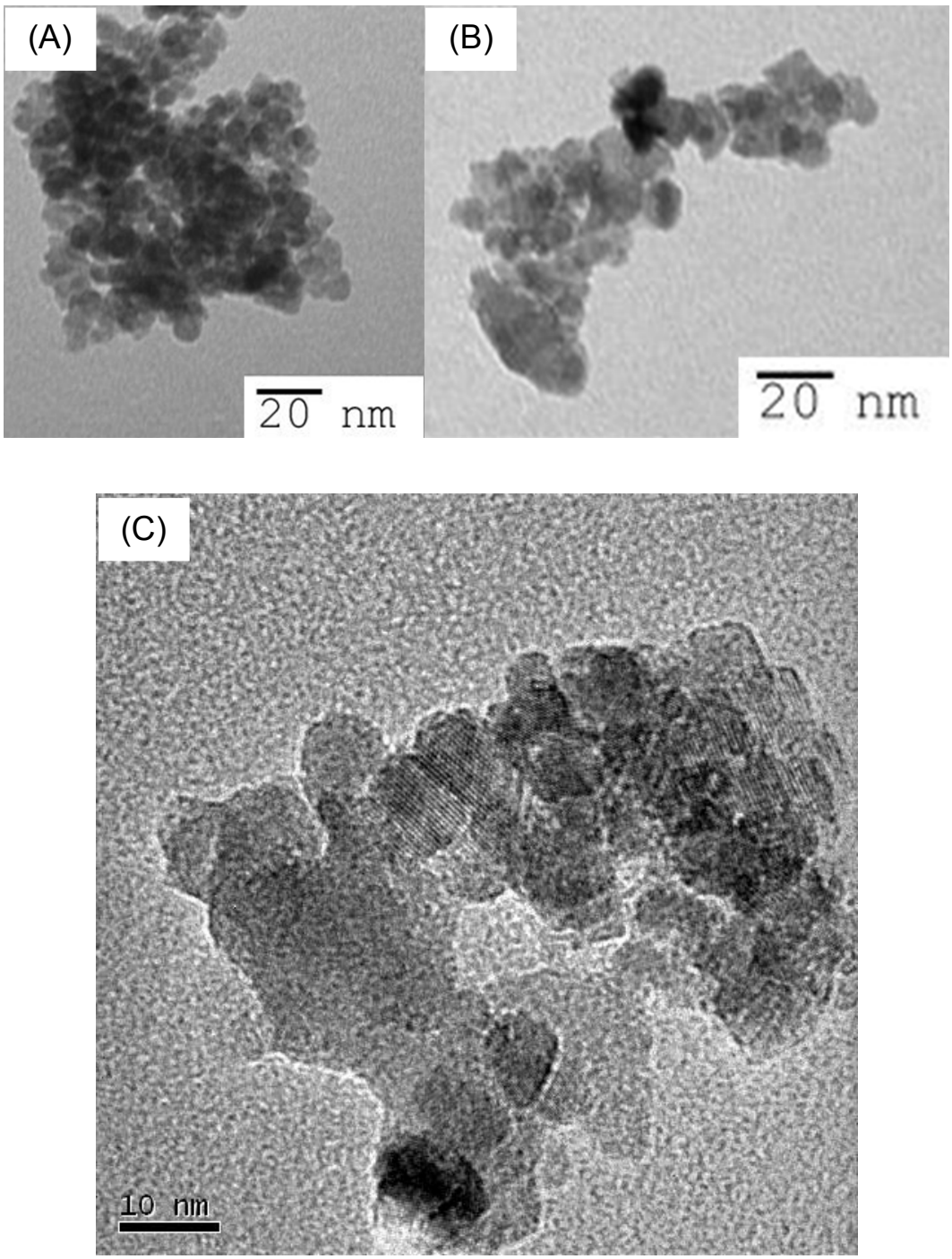
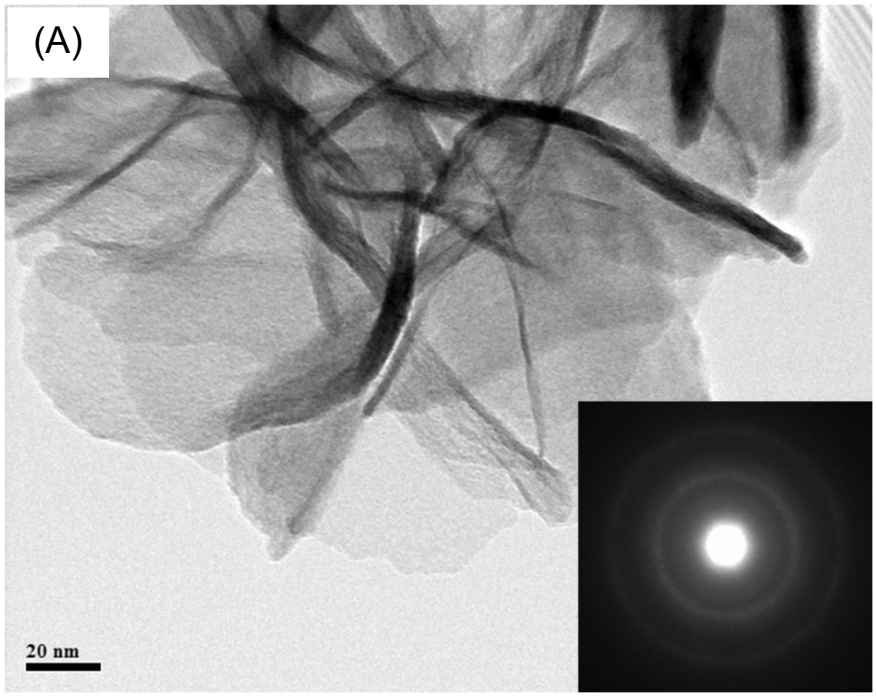
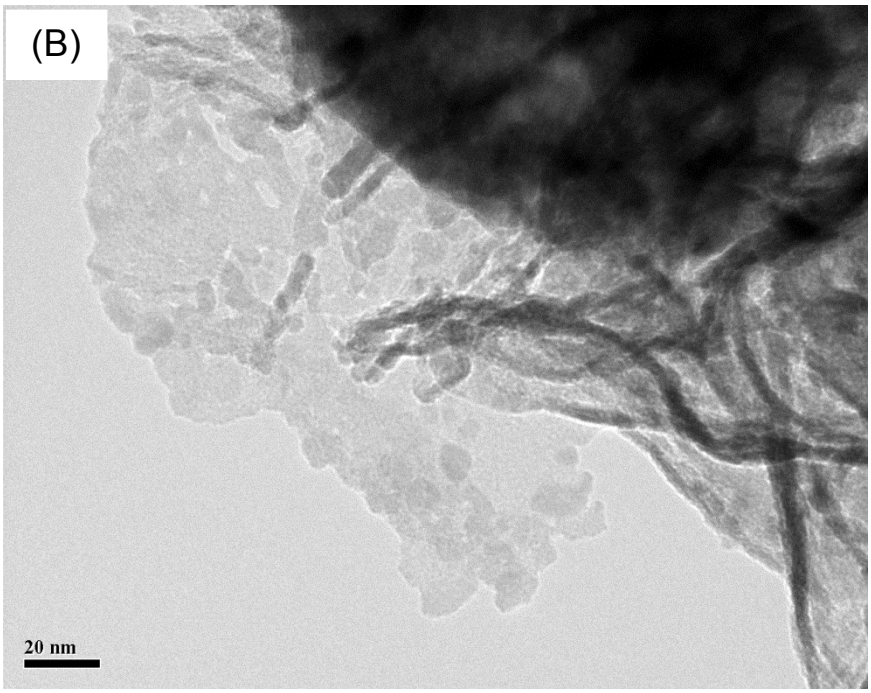
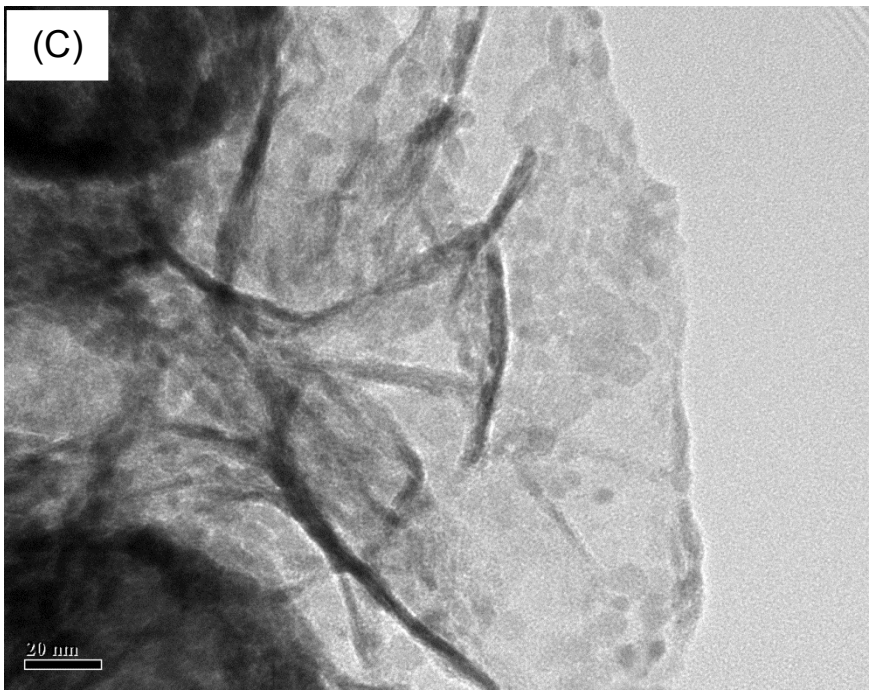


Figure S3: (A) and (B) TEM and (C) HR-TEM micrograph of Mn_3O_4-NP







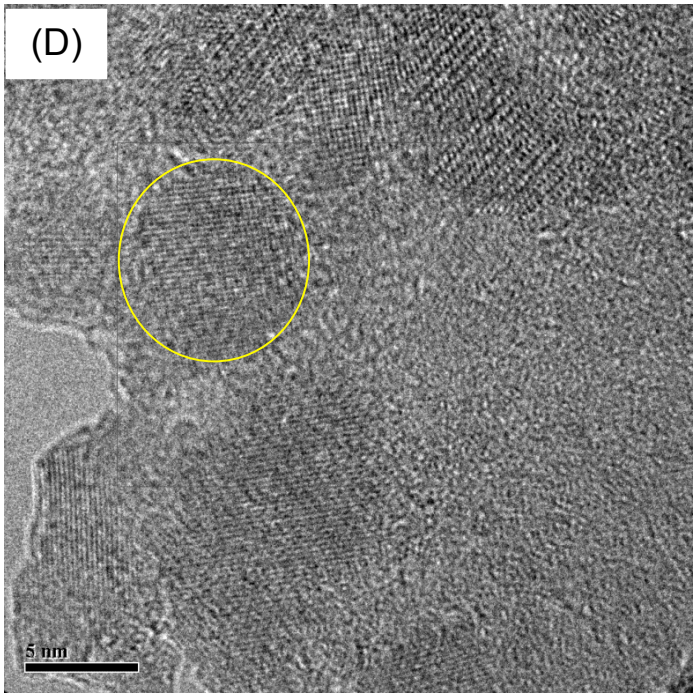
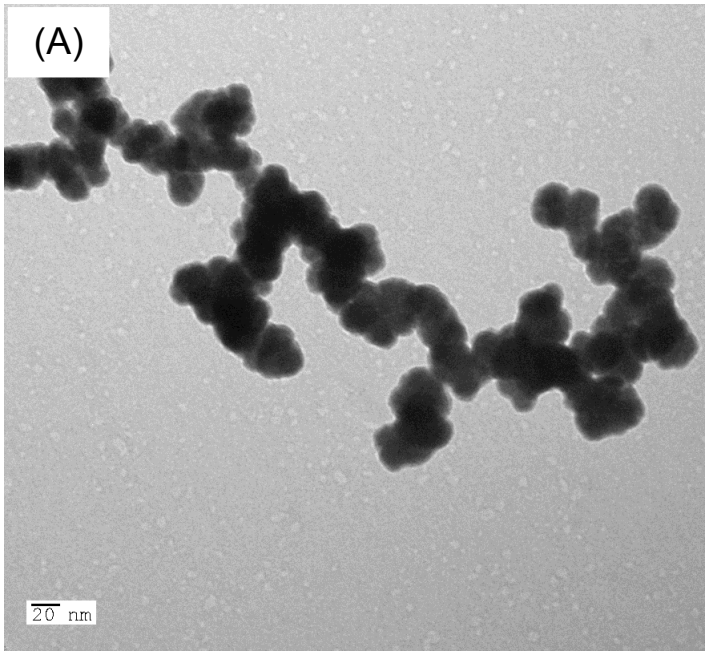
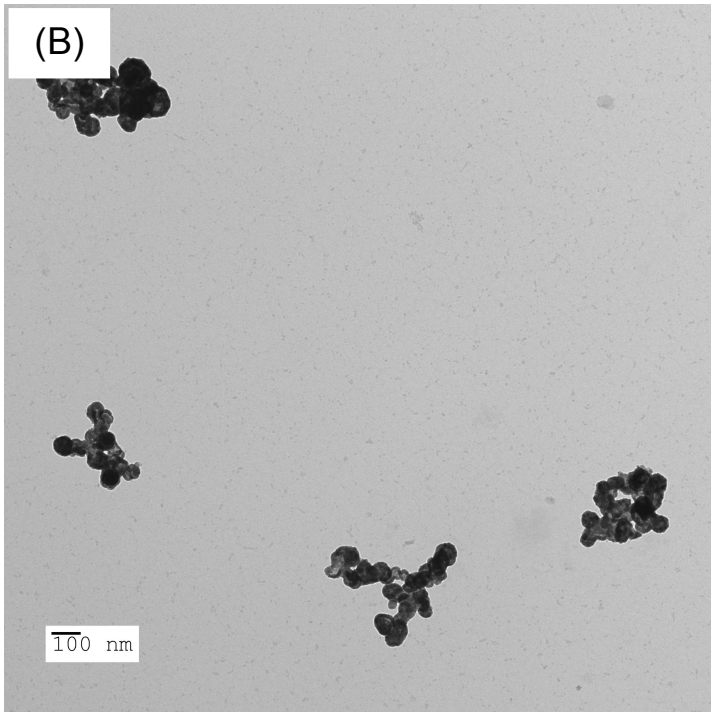
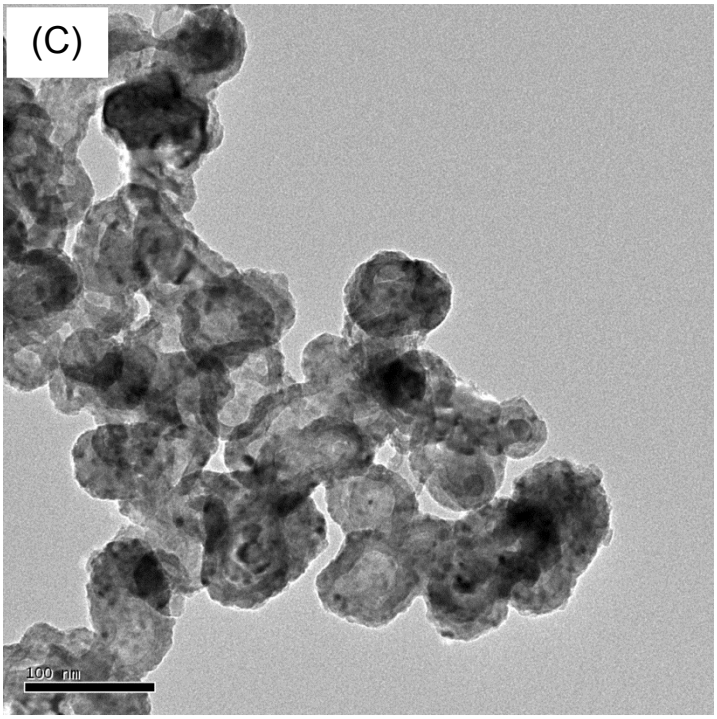
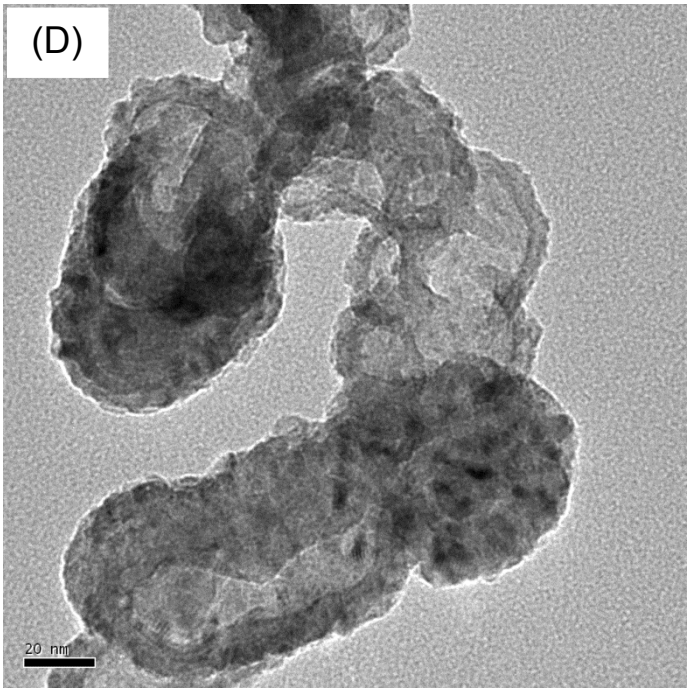


Figure S4: TEM micrographs of (A) Co_3O_4-$NP_{precursor}$ (inset: diffuse ring from SAED indicating amorphous nature), (B) and (C) Co_3O_4-NP from different regions of the grid; (D) HR-TEM of Co_3O_4-NP showing smaller crystalline domains (with lattice fringes) as a part of a larger sheet.









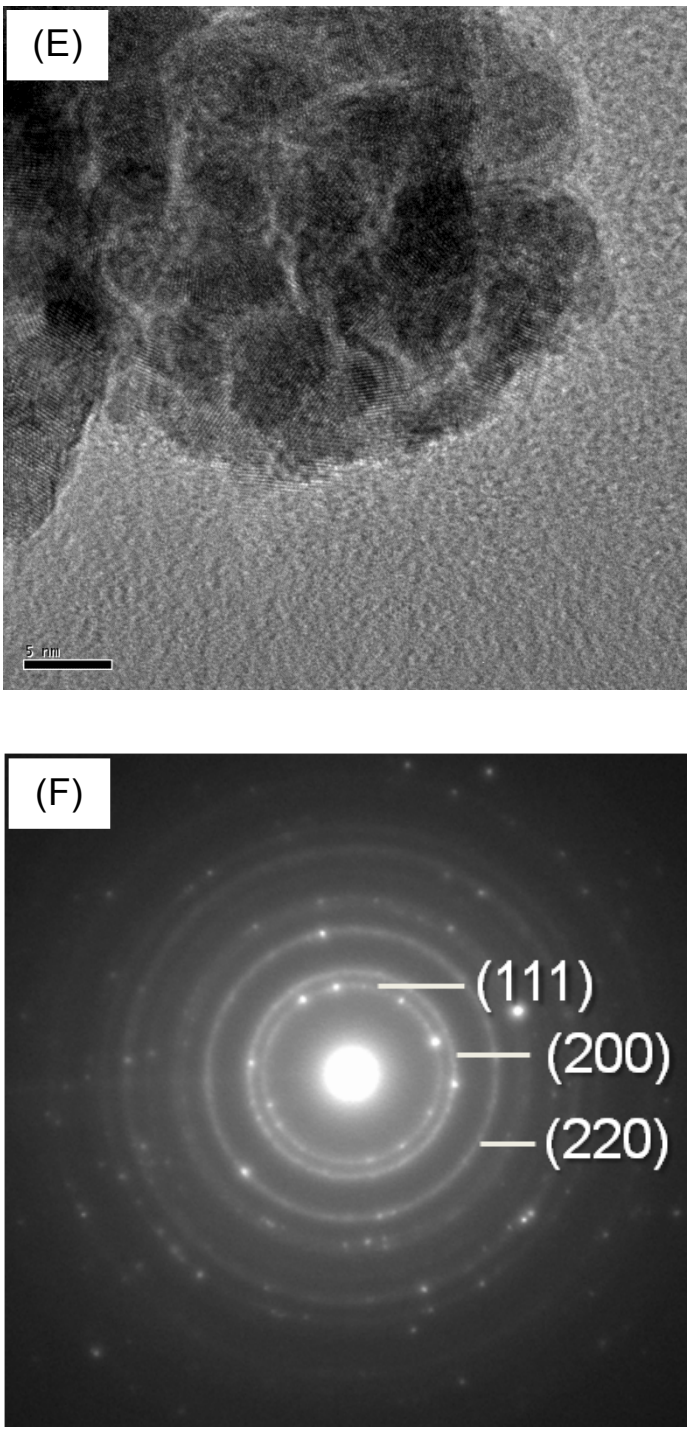


Figure S5: TEM micrographs of (A) Ni/NiO-NP$_{precursor}$, (B) and (C) Ni/NiO-NP from different regions of the grid. (D) HR-TEM and (F) SAED of Ni/NiO-NP.

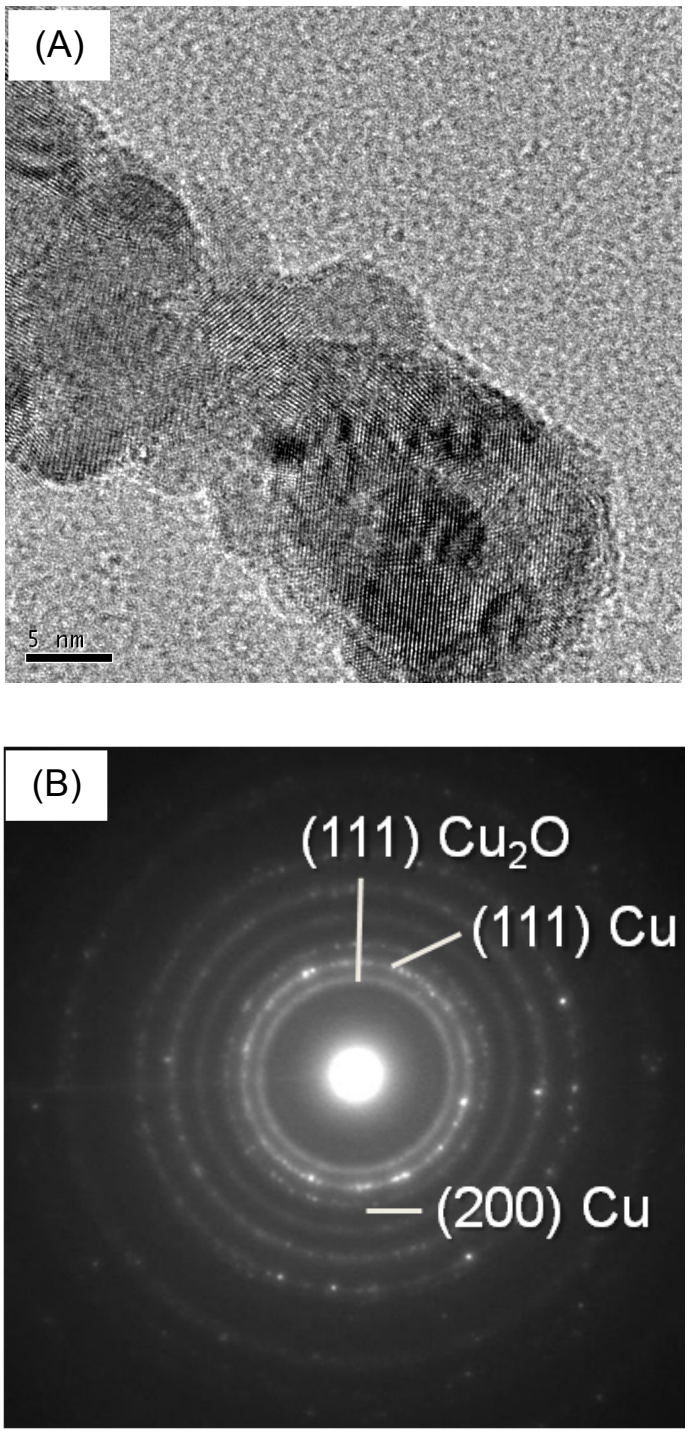


Figure S6: (A) HR-TEM and (B) SAED of Cu/Cu_2O-NP

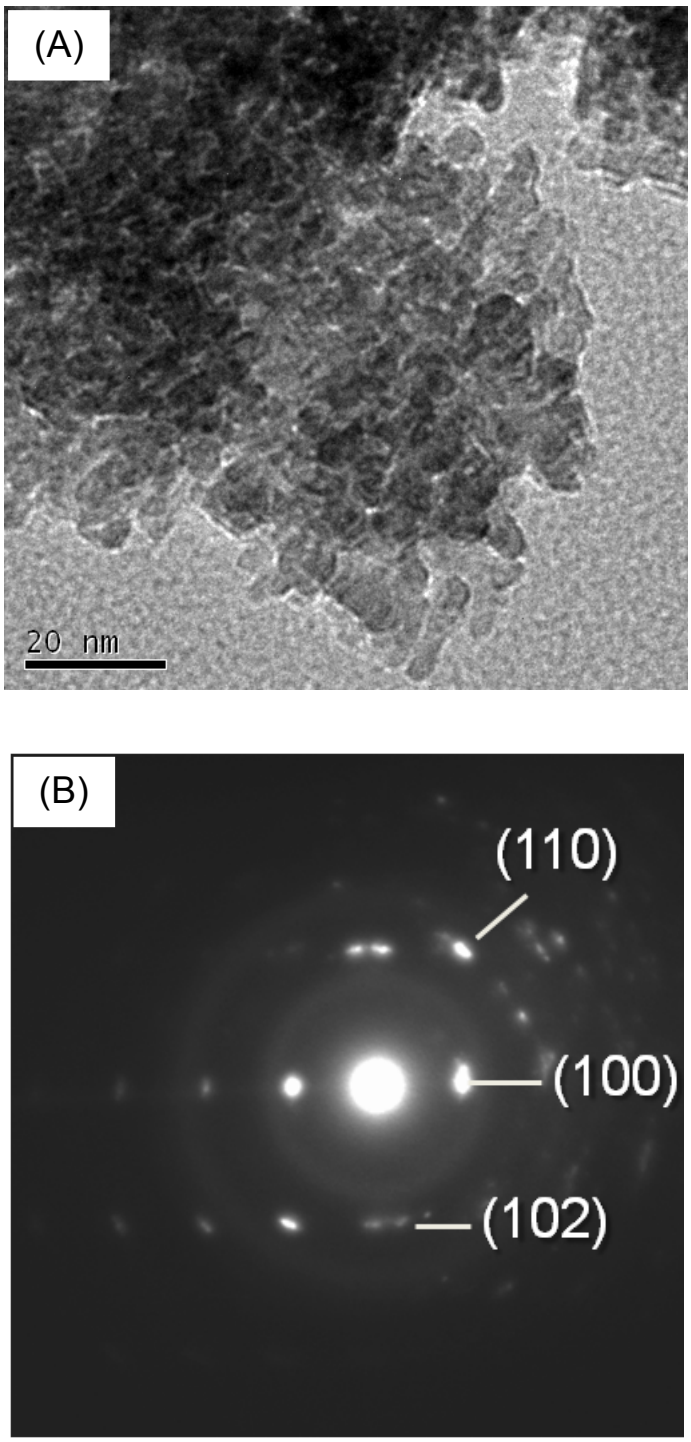


Figure S7: (A) TEM and (B) SAED of ZnO-NP.

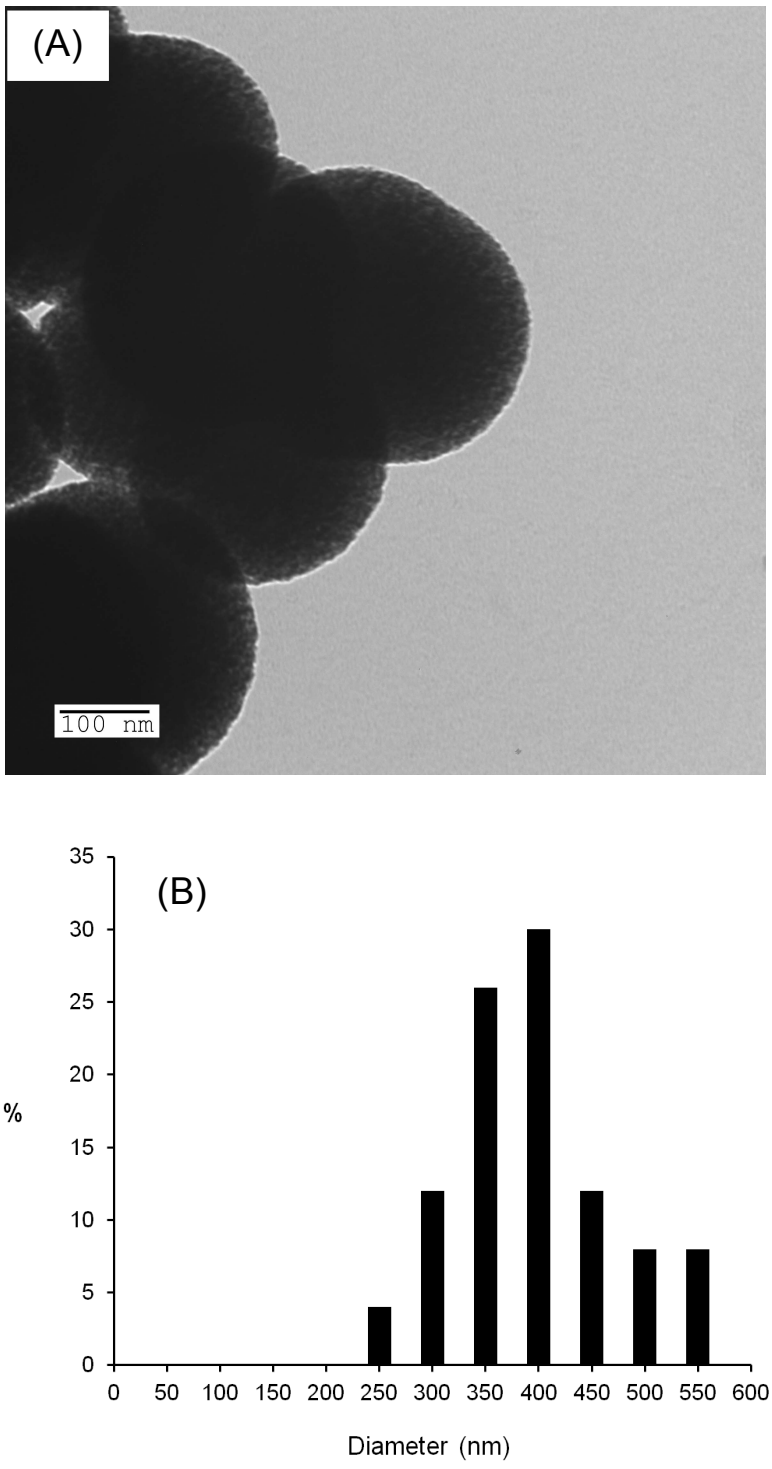


Figure S8: (A) TEM micrograph of SiO_2-NP and (B) Size distribution of SiO_2-NP measured from TEM images.

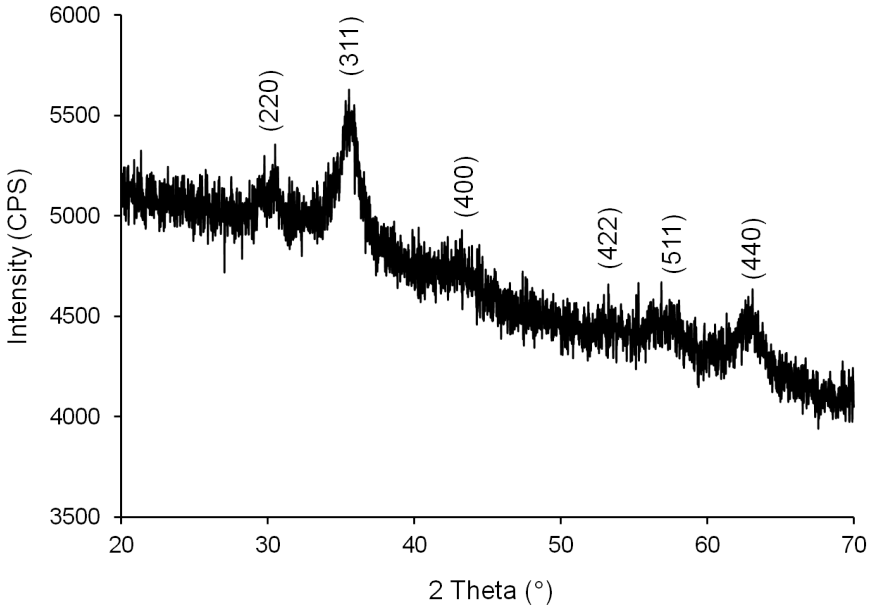


Figure S9: XRD pattern of SiO_2@Fe_3O_4-NP.

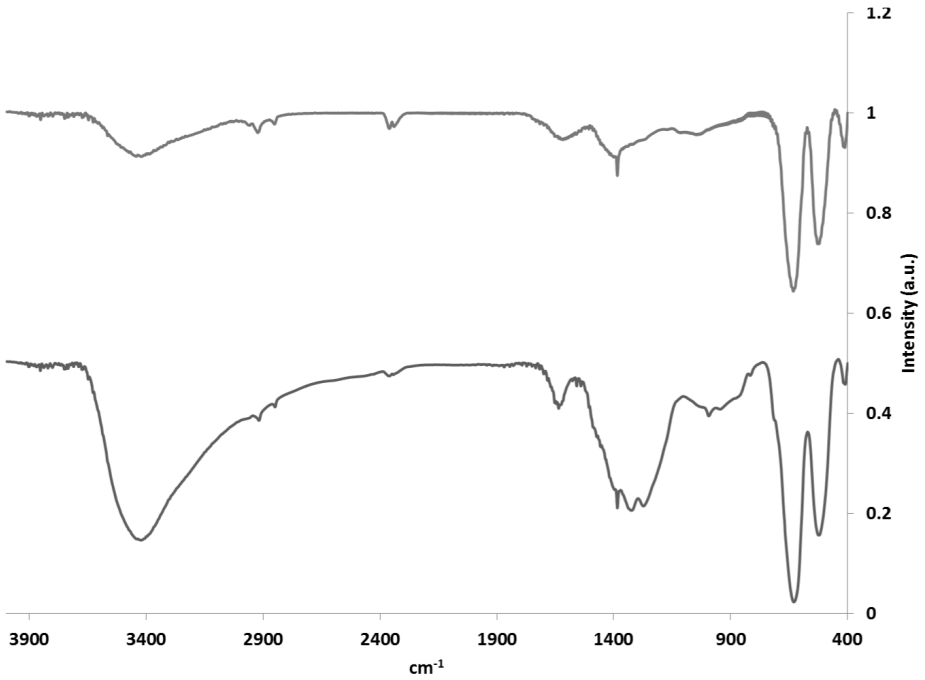


Figure S10: FT-IR spectra for Mn_3O_4-NPs. Top spectrum shows results from synthesis using a 1:1 ratio of $NaBH_4$:$Mn(acac)_3$, bottom spectrum shows a 10:1 ratio. Peaks at ~420 cm^{-1}, ~530 cm^{-1} and ~640 cm^{-1} indicate the presence of pure Mn_3O_4 phase in both samples.