Electronic Supplementary Information for

Synergistic photo optical and magnetic properties of hybrid nanocomposite consisting in a zinc oxide nanorod array decorated with iron oxide nanoparticles

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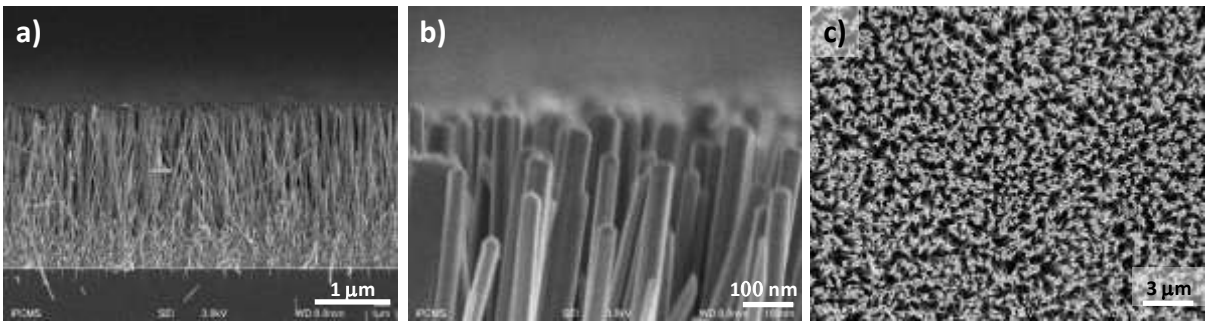

Figure 1S. Micrograph of ZnO nanorods before functionalization by PBA and grafting of iron oxide nanoparticles. a, b) Cross section and c) top views corresponding SEM micrographs.

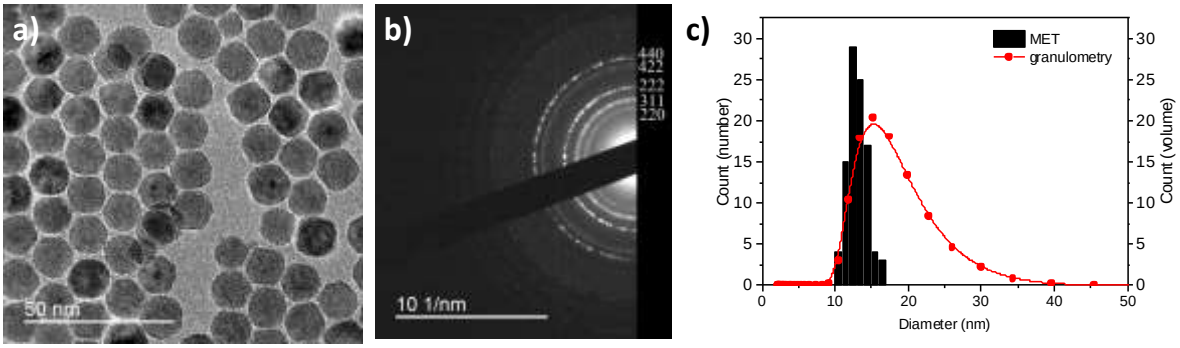

Figure 2S. a) TEM micrograph of $Fe_{3-\delta}O_4$ nanoparticles. b) Electron diffraction pattern showing the crystallinity of nanoparticles which can be assigned to the spinelle structure of iron oxide (magnetite $Fe_{3-\delta}O_4$ JCPDS file 19-629 or maghemite γ-Fe_2O_3 JCPDS file 39-1346 phases). c) Size distribution measured from TEM micrographs and hydrodynamic diameter distribution measured by granulometry

measured from a nanoparticle suspension in THF. The monodisperse hydrodynamic diameter agree with stable suspension of nanoparticles without aggregates.

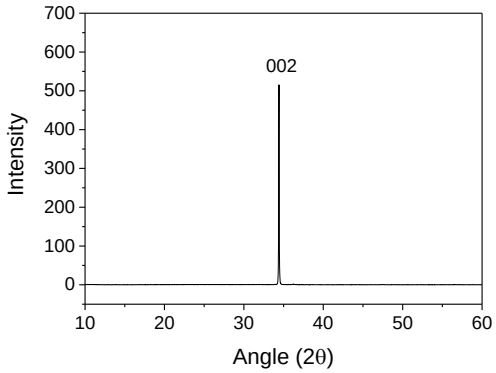

Figure 3S. XRD pattern of ZnO nanorod arrays decorated with $Fe_{3-\delta}O_4$ nanoparticles.

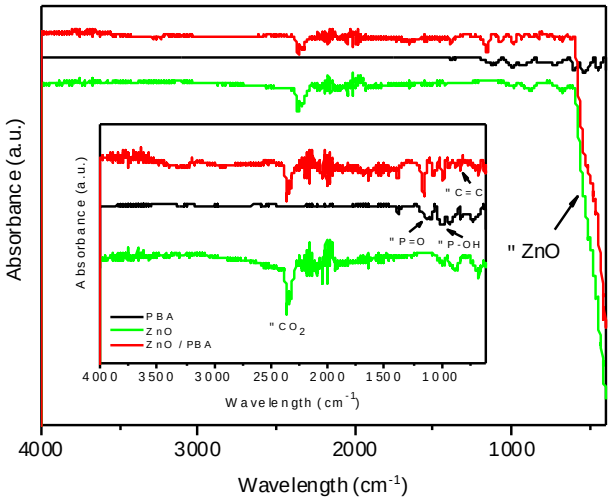

Figure 4S. FTIR spectra of zinc oxide nanorod array functionalized by PBA (ZnO/PBA), 1,4-phenylenebis(phosphonic acid) in the solid state (PBA) and zinc oxide nanorod array (ZnO).

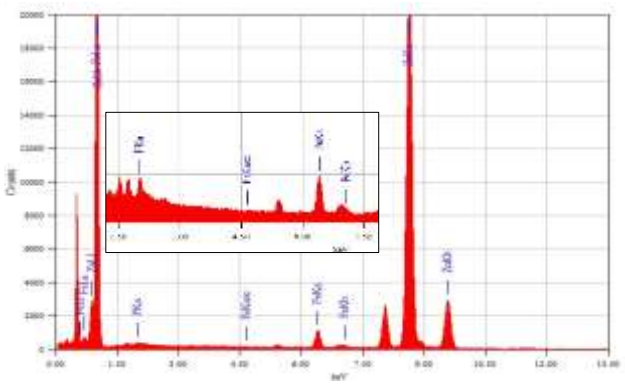

Figure 5S. EDX analysis of $Fe_{3-\delta}O_4$ nanoparticles decorated ZnO nanorod arrays which show the quantitative amount of P and Fe against Zn. Wt. % are Zn:Fe:P, 97:2:1.

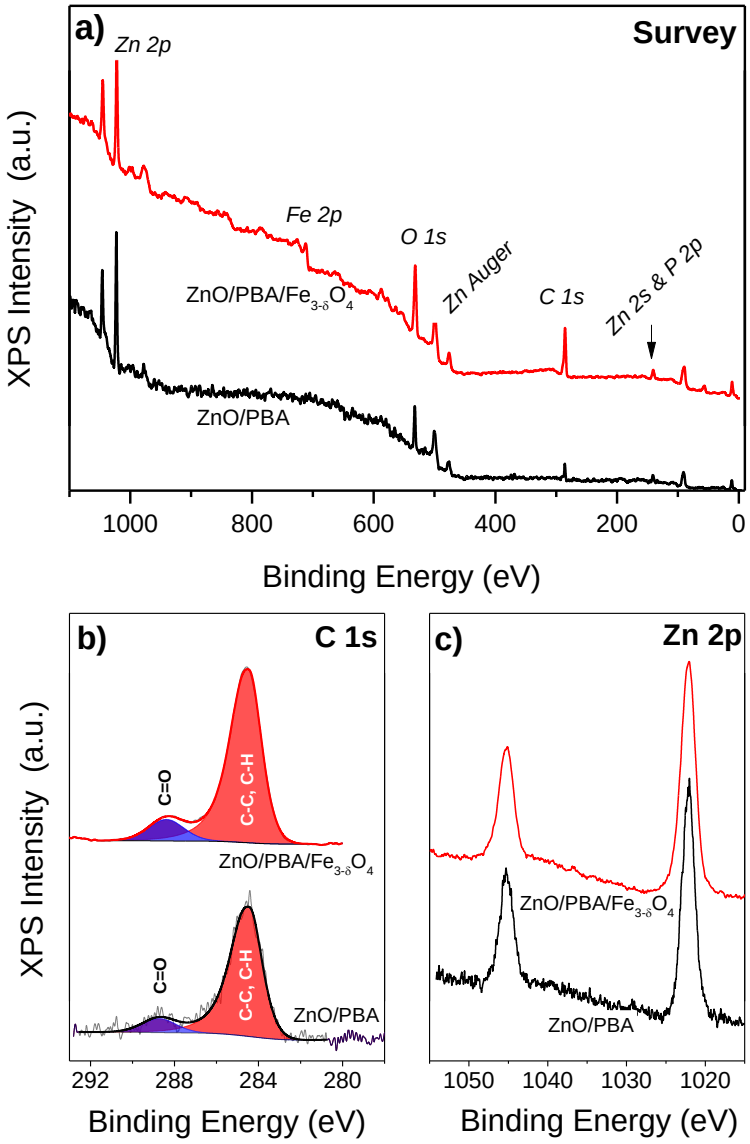

Figure 6S. XPS spectra of ZnO nanorod arrays measured after PBA functionalization (ZnO/PBA) and consequent decoration with $Fe_{3-\delta}O_4$ nanoparticles (ZnO/PBA/ $Fe_{3-\delta}O_4$). a) survey spectra, b) C 1s and c) Zn 2p regions.

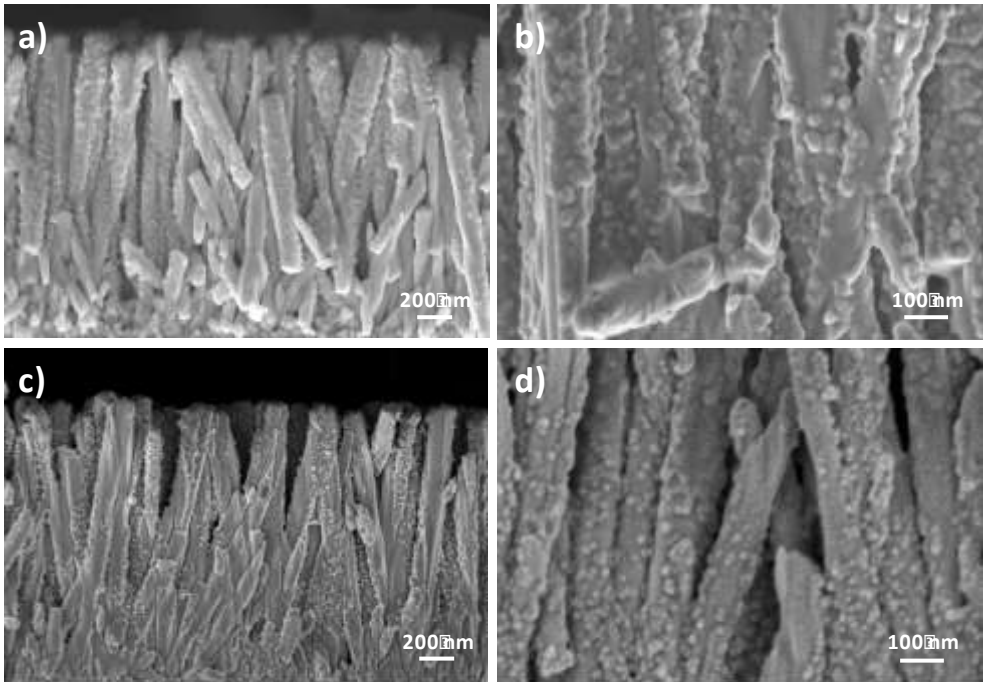

Figure 7S. SEM micrographs of PBA functionalized (0.5 mg/mL, 10 min) ZnO nanorod array after dipping in a suspension of $Fe_{3-\delta}O_4$ nanoparticles for a, b) 10 min and c, d) 7 h.

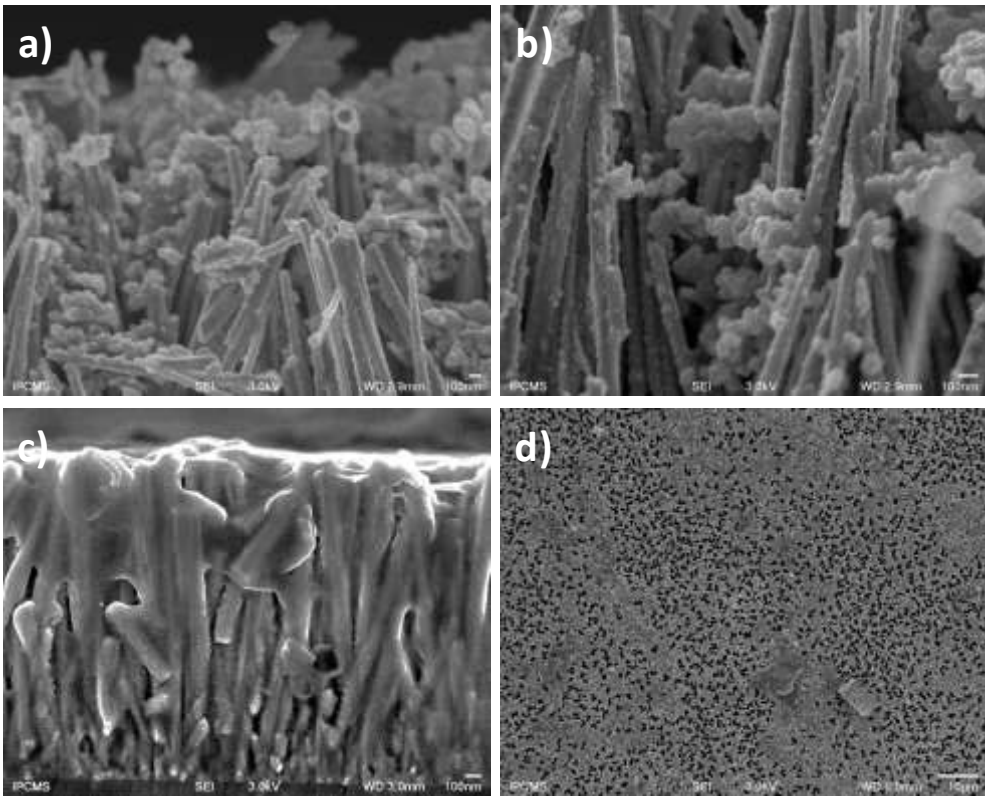

Figure 8S. SEM micrographs of ZnO nanorod arrays after dipping in a PBA solution. a, b) 0.5 mg/mL for 7 h. c, d) 2 mg/mL for 10 min. All samples were subsequently dipped in a followed by dipping in $Fe_{3-d}O_4$ nanoparticle solution for 2 h. a, b, c) are top views. d) is cross section view.

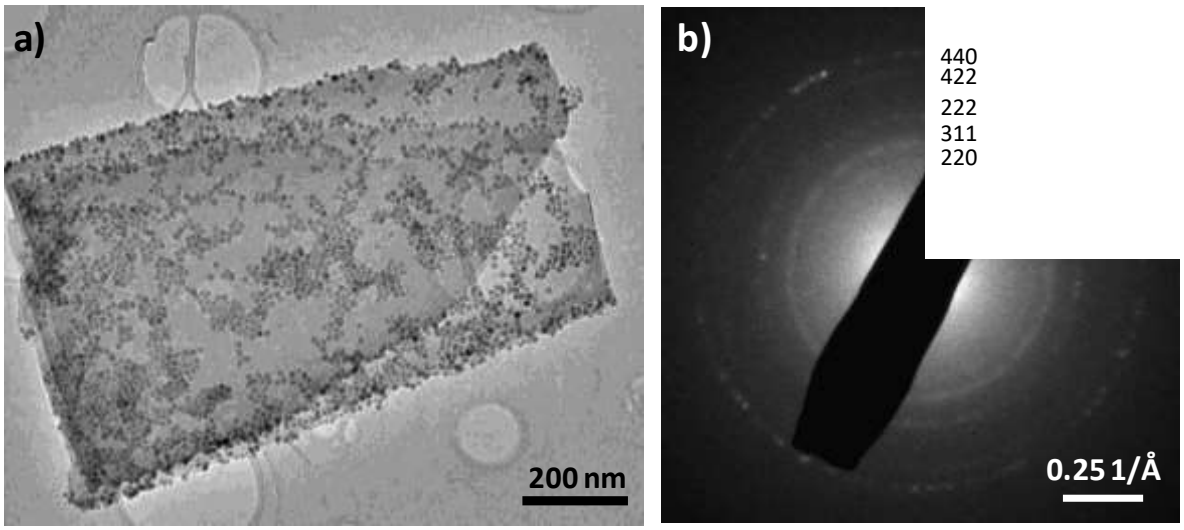

Figure 9S. a) TEM micrograph of a plate-like structure grown on the top of ZnO nanorods which were collected for the top of nanorods after dipping in a $Fe_{3-\delta}O_4$ nanoparticle suspension. b) The corresponding electron diffraction pattern which exhibits rings corresponding to $Fe_{3-\delta}O_4$ nanoparticles grafted at the plate surface. Rings could be indexed to the spinelle structure of iron oxide JCPDS cards n° 19-629 for magnetite and n° 39-1346 for maghemite. These rings could not be indexed to ZnO which show the modification of ZnO structure.

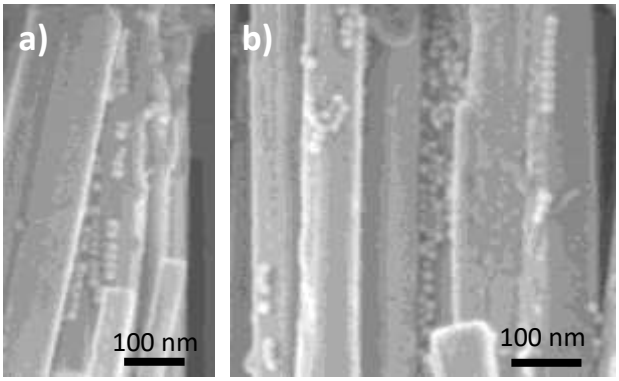

Figure 10S. SEM micrograph showing that some nanoparticles spontaneously aligned as single nanoparticle chains thanks to dipolar interactions.

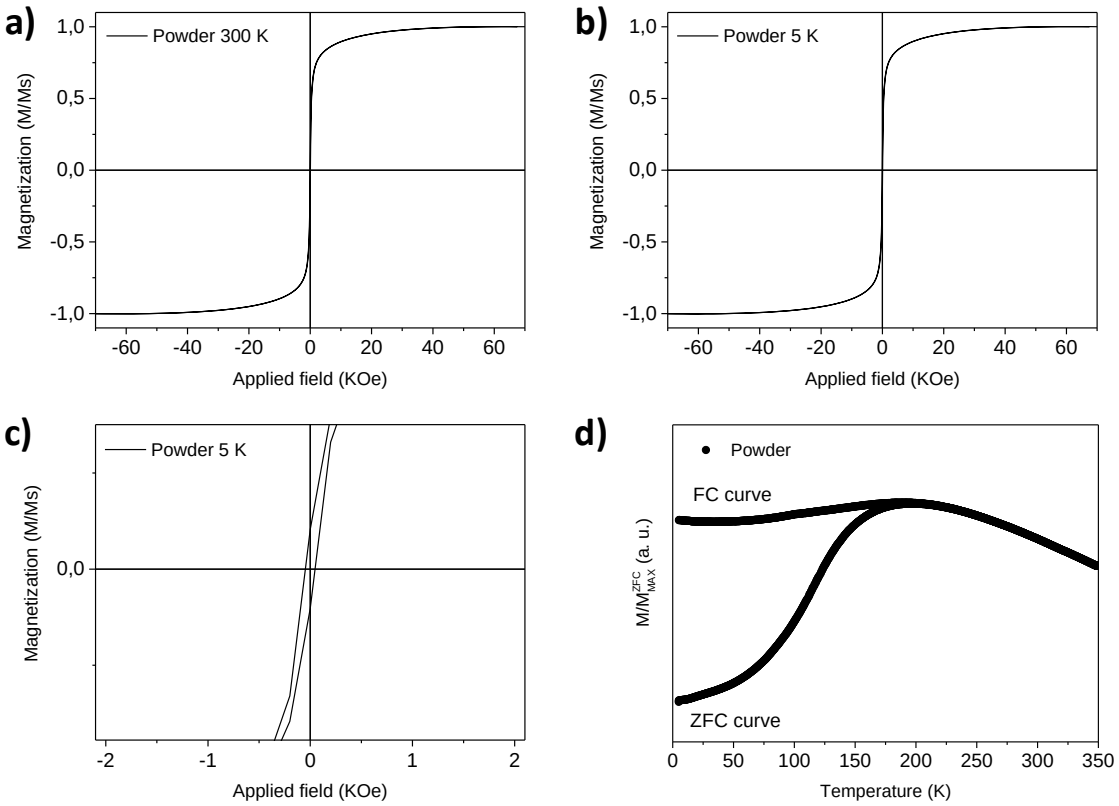

Figure 11S. Magnetic measurements of $Fe_{3-\delta}O_4$ nanoparticles in the powder state. a) Magnetization recorded against a magnetic field at a) 300 K and b, c) at 5 K. c) shows the low field region in b). d) Magnetization curve recorded against temperature after cooling down with no magnetic field (ZFC curve) and after cooling down under a 75 Oe magnetic field (FC curve).

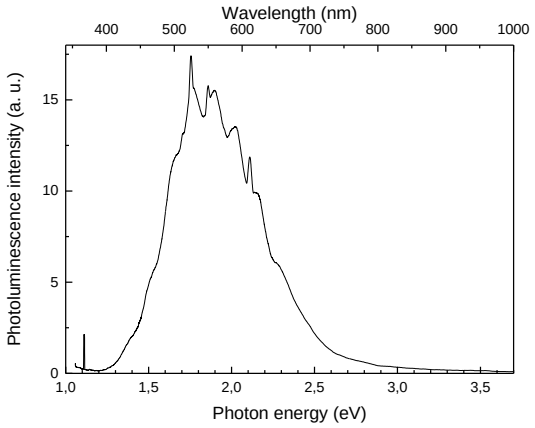

Figure 12S. Photoluminescence spectra of $Fe_{3-\delta}O_4$ nanoparticles drop casted on a glass substrate. Spectral fringes are visible here because no filtering of the spectrum could be performed without also removing sharp structures (at 525, 550 and 610 nm) that seems to be characteristic of $Fe_{3-\delta}O_4$.