

Article

# Preparation and characterization of magnetic $\text{Fe}_3\text{O}_4/\text{CdWO}_4$ and $\text{Fe}_3\text{O}_4/\text{CdWO}_4/\text{PrVO}_4$ nanoparticles and investigation of their photocatalytic and anticancer properties on PANC1 cells

Mohammad Amin Marsooli <sup>1,2</sup>, Mahdi Fasihi-Ramandi <sup>1,2</sup>, Kourosch Adib <sup>3</sup>, Saeid Pourmasoud <sup>4</sup>, Farhad Ahmadi <sup>5,6</sup>, Mohammad Reza Ganjali <sup>7,8</sup>, Ali Sobhani Nasab <sup>9,10</sup>, Mahdi Rahimi Nasrabadi <sup>1,2,\*</sup> and Marta E. Plonska-Brzezinska <sup>11,\*</sup>

<sup>1</sup> Department; Nanobiotechnology Research Center, Baqiyatallah University of Medical Sciences, Tehran postcode, Iran; mohammadamin.marsuli@gmail.com.

<sup>2</sup> Faculty of Pharmacy, Baqiyatallah University of Medical Sciences, Tehran postcode, Iran; fasihi.m@gmail.com.

<sup>3</sup> Department of Chemistry, Imam Hossein University, Tehran postcode, Iran; k\_anbaz@yahoo.com.

<sup>4</sup> Department of Physics, University of Kashan, Kashan postcode, Iran; SA\_POURMASOUD2007@yahoo.com.

<sup>5</sup> Physiology Research Center, Iran University of Medical Sciences, Tehran postcode, Iran; Farhadahmadi55@gmail.com.

<sup>6</sup> Department of Medicinal Chemistry, School of Pharmacy-International Campus, Iran University of Medical Sciences, Tehran postcode, Iran.

<sup>7</sup> Center of Excellence in Electrochemistry, Faculty of Chemistry, University of Tehran, Tehran postcode, Iran; Ganjali@gmail.com.

<sup>8</sup> Biosensor Research Centre, Endocrinology & Metabolism Molecular and Cellular Research Institute, Tehran University of Medical Sciences, Tehran postcode, Iran.

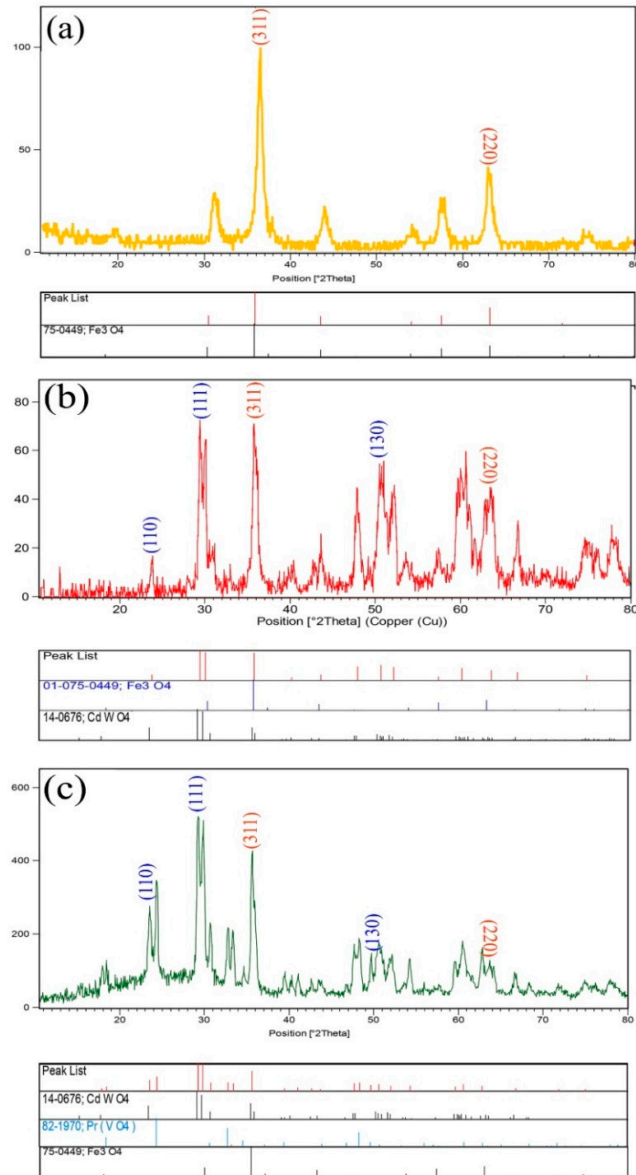
<sup>9</sup> Social Determinants of Health (SDH) Research Center, Kashan University of Medical Sciences, Kashan postcode, Iran; Ali.sobhaninasab@gmail.com.

<sup>10</sup> Core Research Lab, Kashan University of Medical Sciences, Kashan postcode, Iran.

<sup>11</sup> Department of Organic Chemistry, Faculty of Pharmacy with the Division of Laboratory Medicine, Medical University of Bialystok, Mickiewicza 2A, 15-222 Bialystok, Poland; marta.plonska-brzezinska@umb.edu.pl.

\* Correspondence: Rahiminasrabadi@gmail.com; Tel.: +98 2182483409 (M.R.N.); marta.plonska-brzezinska@umb.edu.pl (M.E.P-B.)

Received: 06 September 2019; Accepted: 04 October 2019; Published: date



**Figure S1.** XRD patterns of (a)  $\text{Fe}_3\text{O}_4$ , (b)  $\text{Fe}_3\text{O}_4/\text{CdWO}_4$  (S1), and (c)  $\text{Fe}_3\text{O}_4/\text{CdWO}_4/\text{PrVO}_4$  (S4).

**Table S1.** Main reflections in XRD patterns of inorganic nanoparticles.

Sample	2 $\theta$ (degrees)	hkl	Crystallite sizes Dc (nm)	Average Crystallite size	A (A)	B (A)	C (A)
$\text{Fe}_3\text{O}_4$	35.6	(311)	14.58	14.1	8.3740	8.3740	8.3740
	63.1	(220)	13.71				
$\text{Fe}_3\text{O}_4/\text{CdWO}_4$	35.6	(311)	15.31	33.5	5.0290	5.8590	5.0740
	63.1	(220)	14.65				
	23.20	(110)	11.45				

	29.00	(111)	12.45				
	51.11	(130)	13.48				
	35.6	(311)	15.96				
	63.1	(220)	15.22				
	23.20	(110)	12.43				
<b>Fe<sub>3</sub>O<sub>4</sub>/CdWO<sub>4</sub>/PrVO<sub>4</sub></b>	29.00	(111)	13.24	55	7.3990	7.3990	6.4960
	51.11	(130)	14.35				
	24.03	(200)	11.86				
	32.40	(112)	12.77				
	47.86	(322)	13.98				

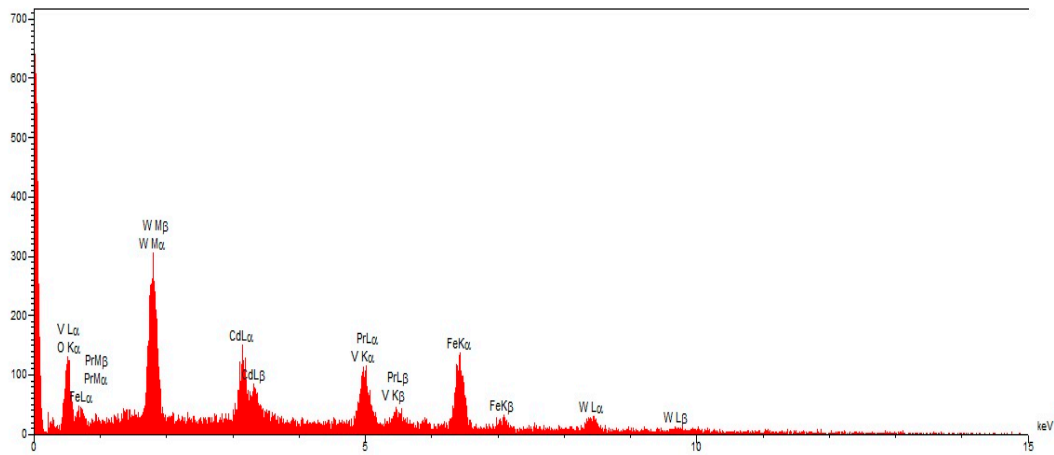


Figure S2. EDX spectrum of the Fe<sub>3</sub>O<sub>4</sub>/CdWO<sub>4</sub>/PrVO<sub>4</sub> (S<sub>4</sub>) sample.

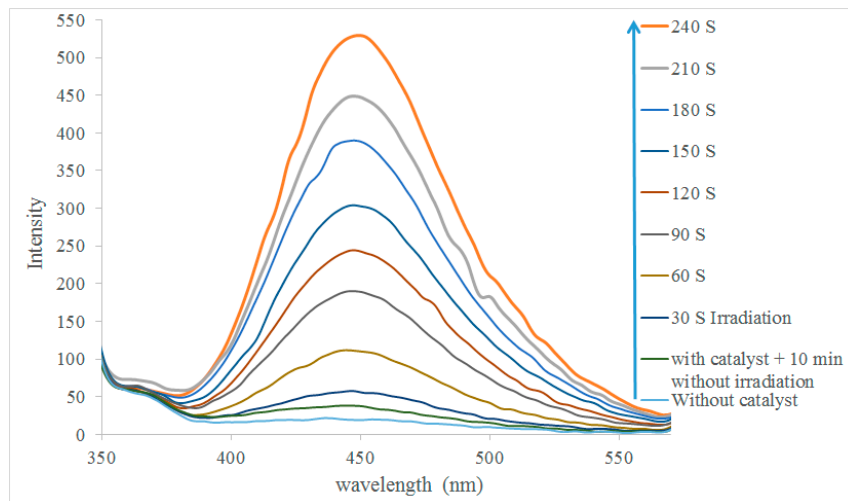
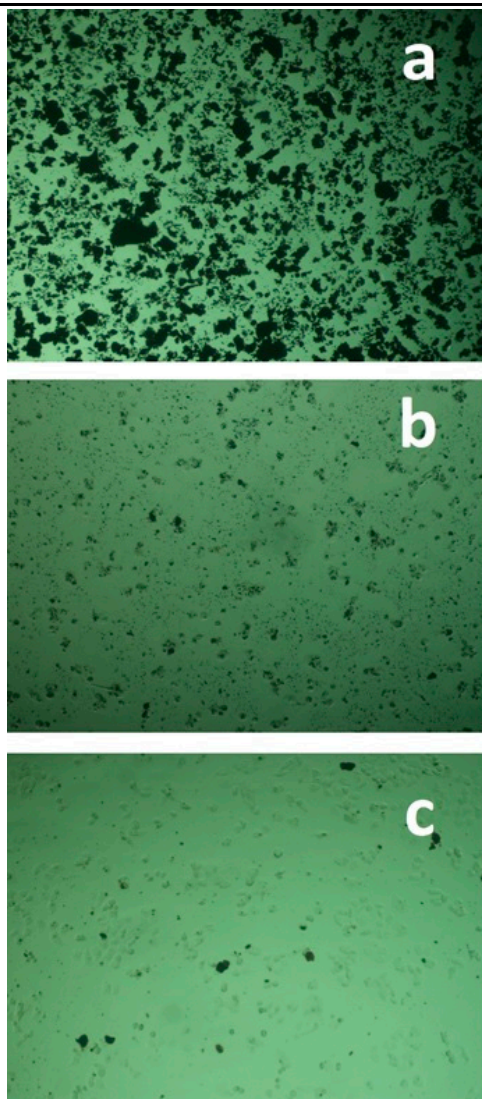


Figure S3. The temporal changes in fluorescence intensity under UV light (290 nm) irradiation for S<sub>4</sub>.

Table S2. The photoluminescence technique was used to study the generation of active •OH radicals for all sample (S1-S5).

Sample	Intensity (after 240 s of irradiation)
S1	350
S2	410
S3	485
S4	525
S5	500



**Figure S4.** Microscopic photograph of PANC1 cell in the presence of S4 at three concentrations (a) 2, (b) 0.5, and (c) 0.0157 mg/mL.