Electronic Supplementary Material (ESI) for Environmental Science: Nano

Supporting Information

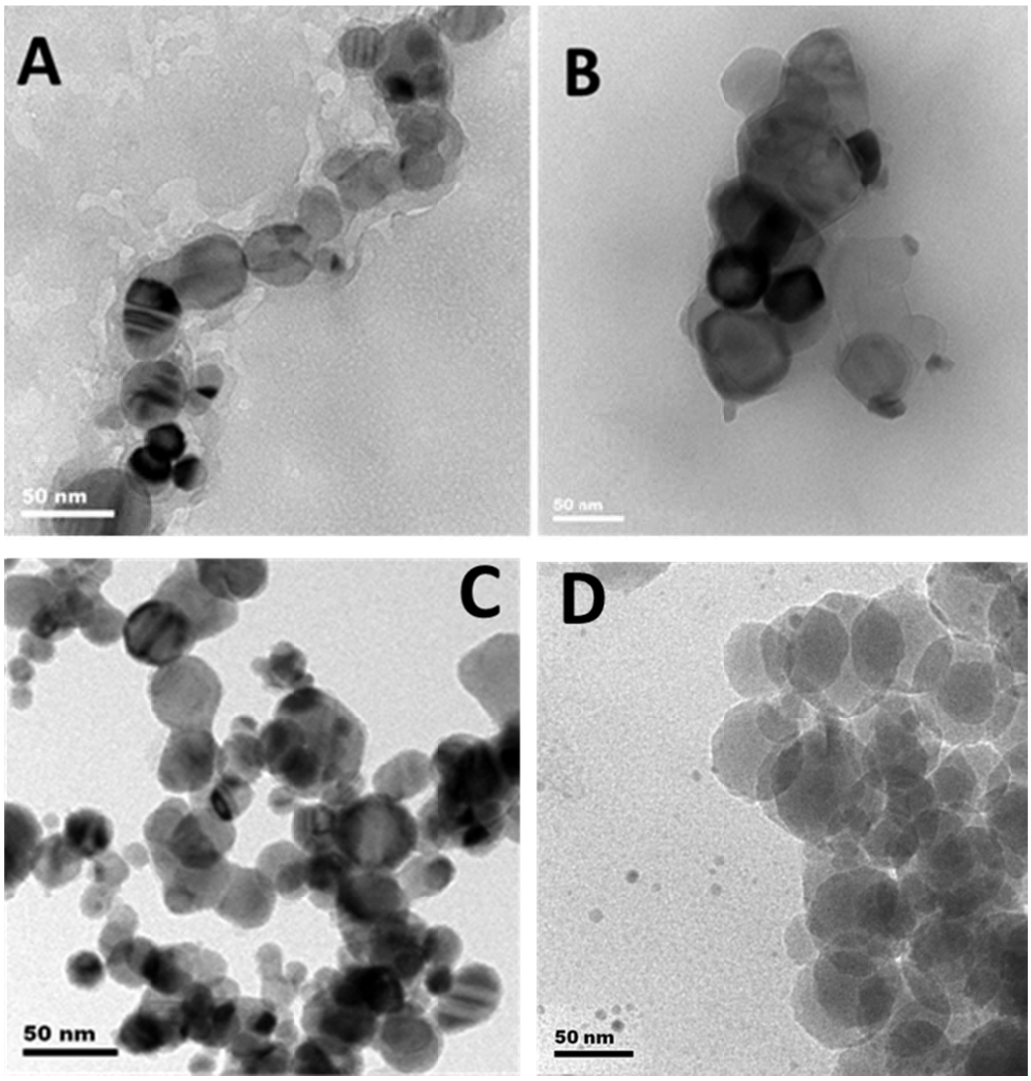

Figure S1. TEM micrographs of fresh Ni (A) and CuO (B), and aged for four days Ni (C) and CuO (D) NPs in E3. NP dispersions analysed were dried directly on a regular copper grid.

To investigate the effect NP aging in E3 on the Ni and CuO NP structure, TEM micrographs were taken before and after incubation in E3 at 28.5 ^{o}C for four days. Individual NP size and shape were found unchanged but larger clusters were observed after the course of incubation.

Table SI. Size and ζ-potential of Ni and CuO NPs.

NPs	Water		PBS (pH 7.4)		E3	
	d (nm)	ζ	d (nm)	ζ	d (nm)	ζ
Ni	304.1 ± 11.9	-18.29 ± 0.36	754.2 ± 30.8	-28.93 ± 0.85	673.7 ± 81.1	15.7± 2.52
CuO	671.4 ± 86.9	-29.73 ± 1.24	560.2 ± 40.0	-29.13 ± 3.47	437.9 ± 34.1	-32.72 ± 1.43

ζ–potential and particle size distribution values were tabulated as mean ± standard error (n=5).

Table SII. Size and ζ-potential of 4-days aged Ni and CuO NPs in E3.

NPs	E3	
	d (nm)	ζ
Ni	468.9 ± 3.2	9.59 ± 0.83
CuO	618.3 ± 99.4	-27.12 ± 5.57

ζ–potential and particle size distribution values were tabulated as mean ± standard error (n=5).

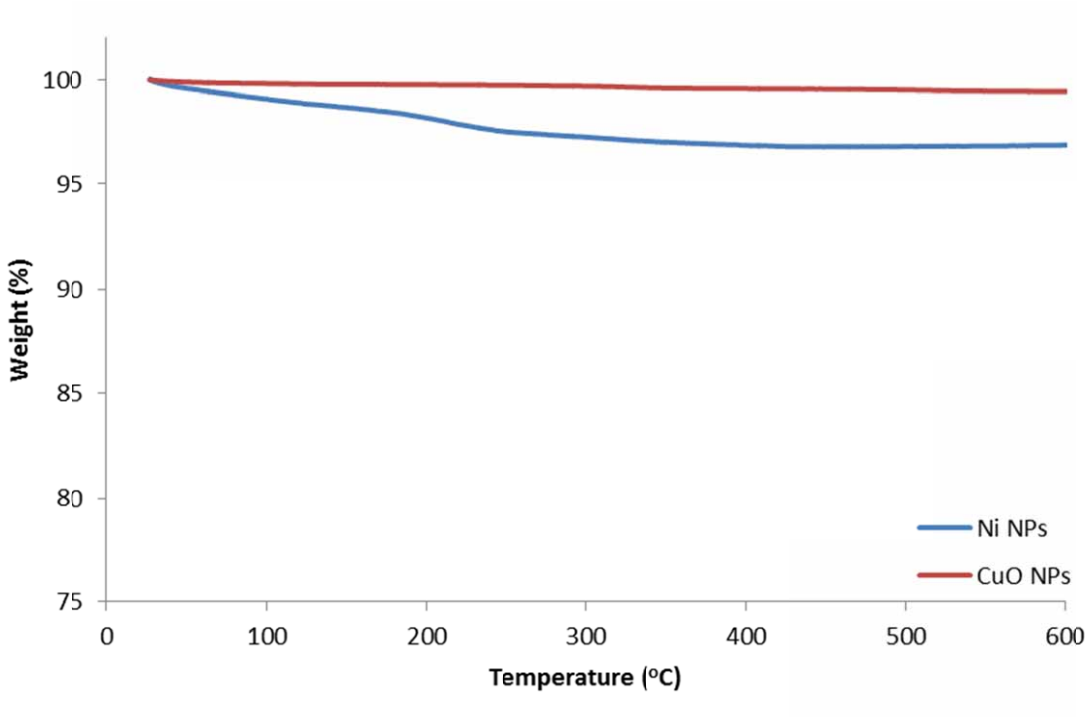

Figure S2. Thermogravimetric analysis (TGA) curves of Ni and CuO NPs at a heating rate of 10 ^{o}C/min in N_2.

The TG curve of CuO NPs demonstrated a weight loss of 0.6 % of the initial particle amount. Initial weight loss up to 100^{o}C corresponds to evaporation of H_2O present on the particles. Additionally, two small weight loss steps of 0.1 % have been observed at ~ 300 and 500 ^{o}C which are potentially due to post-synthesis impurities. The TG curve for Ni NPs showed a total weight loss of ~ 3.1 % versus the initial amount of the specimen. The removal of H_2O resulted in a decrease of 1% of the initial weight. Further weight loss can be due to the decomposition of nickel hydroxide into nickel oxide and water which eventually evaporates at high temperatures.[1]

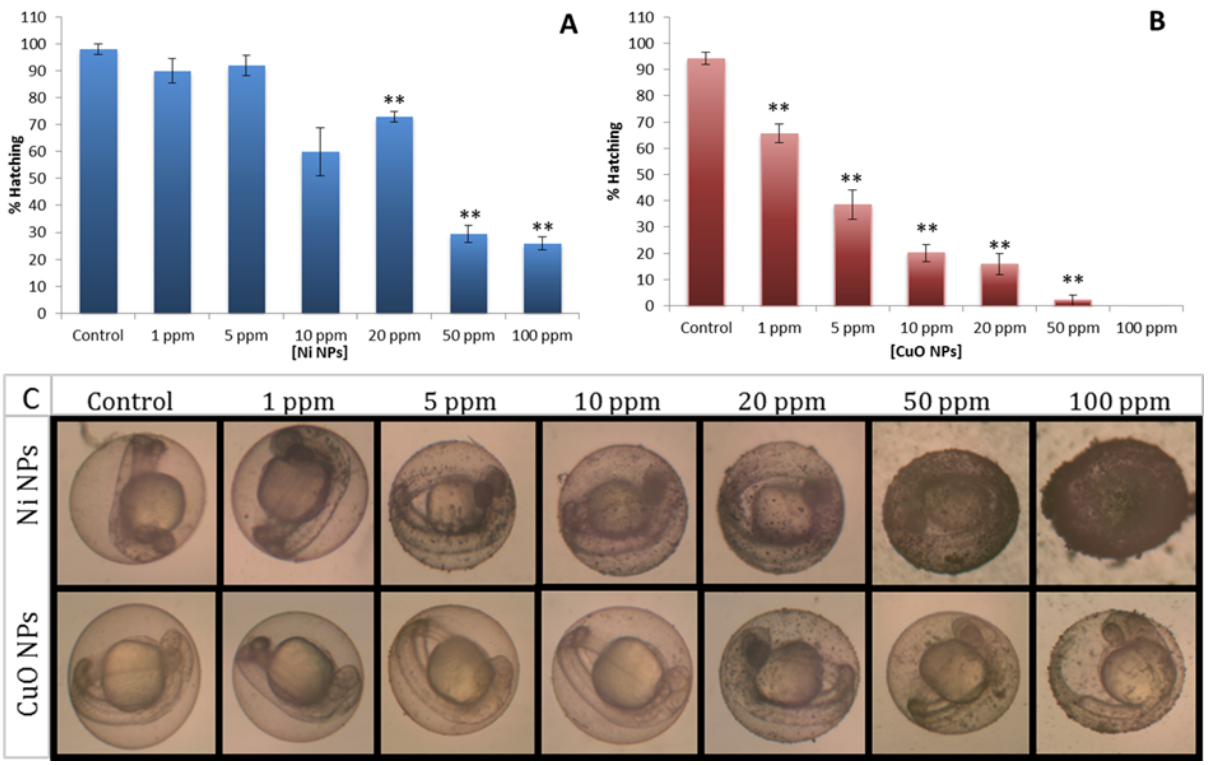

Figure S3. Effect of NPs on embryonic development. Assessment of the hatching percentage of zebrafish embryos at 72 hpf after exposure to increasing doses of Ni (A) and CuO (B) NPs. Representative microscope images of zebrafish embryos exposed to NPs dispersion, including the unexposed control embryos (C). The average percentage values were calculated from 5 replicate trials, consisting of 10 embryos per each concentration. Error bars represents ± mean standard deviation. Two asterisks indicate $p < 0.001$.

Figure S4. Representative micrographs of unhatched zebrafish embryos after CuO NPs exposure. The image on the left is a typical example of a disintegrated embryo as well as the one in the middle. Finally, the image on the right shows a dead but fully intact unhatched embryo.

High concentrations (50 – 100 ppm) of CuO NPs had a lethal effect on the zebrafish embryos. 50 ppm CuO nanoparticle dispersion resulted in more than 30% mortality while 100 ppm CuO NPs exposure induced 50% mortality of the total population.

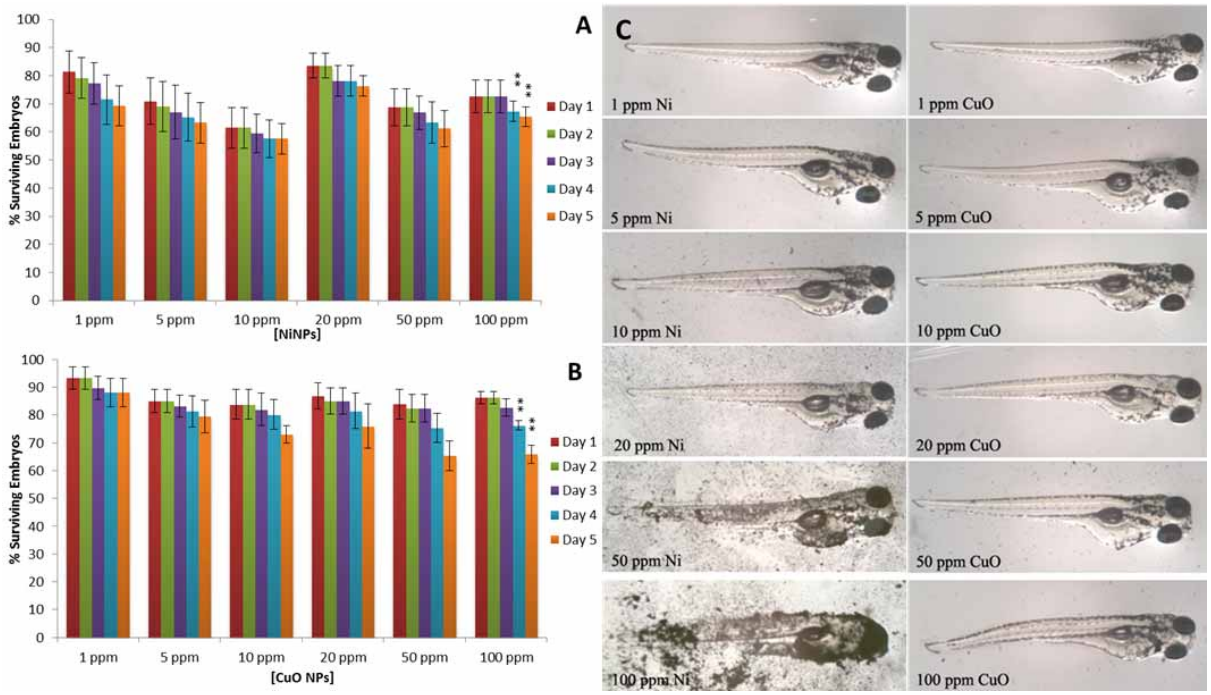

Figure S5. Effect of NPs on viability of zebrafish embryos. Assessment of the survival percentage of zebrafish embryos after exposure to increasing doses of Ni (A) and CuO (B) NPs. Ni NPs form accumulation on the 5 dpf embryos surface between with increasing concentrations (C right panel); while CuO NPs does not (C left panel). The average percentage values were calculated from 5 replicate trials, consisting of 10 embryos per each concentration. Error bars represents ± mean standard deviation. Two asterisks indicate $p < 0.001$.

References:

1. A.Al-Hajry, A. Umar, M. Vaseem, M.S. Al-Assiri, F. El-Tantawy, M. Bououdina, S. Al-Heniti, Y.-B. Hahn, *Superlattices and Microstructures,* **44**, 216-222.