

Effects of Surface Coating Properties on the Sorption and Dissolution of ZnO Nanoparticles in Soil

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Supplementary Information

Tables

Table S1 pH of 25 mg Zn L⁻¹ as ZnO NPs in particle free soil solution (PFSS), deionized (DI) water and moderately hard reconstituted water (MHRW) at 0, 25, and 100 mg C L⁻¹

Medium	PPHA (mg C L ⁻¹)	Bare ZnO	Core-shell pH	DEX	DEX-(SO ₄)
DI	0	6.67 ± 0.01	7.38 ± 0.06	7.43 ± 0.15	7.33 ± 0.05
DI	25	8.43 ± 0.06	7.67 ± 0.21	8.30 ± 0.10	7.74 ± 0.06
DI	100	9.10 ± 0.06	8.52 ± 0.12	8.92 ± 0.14	8.89 ± 0.03
MHRW	0	6.65 ± 0.06	6.93 ± 0.06	6.93 ± 0.05	6.72 ± 0.15
MHRW	25	7.18 ± 0.06	7.18 ± 0.04	7.30 ± 0.01	7.07 ± 0.01
MHRW	100	8.08 ± 0.18	8.06 ± 0.12	8.01 ± 0.10	8.02 ± 0.13
PFSS pH6	-	6.23 ± 0.04	6.12 ± 0.12	6.48 ± 0.08	6.42 ± 0.07
PFSS pH8	-	8.00 ± 0.05	7.84 ± 0.06	7.97 ± 0.09	7.90 ± 0.12

Table S2 Sorption isotherm parameters for ZnO NPs and dissolved organic carbon (DOC) sorption studies

ZnO NP treatment	r ²	P at α=0.05	K (mg ^(1-1/n) . g ⁻¹ .L ^(1/n))	n	1/n
Bare-ZnO	0.971	0.0021	0.054	2.31	0.433
Core-shell	0.993	0.0003	0.041	1.94	0.515
DEX	0.981	0.0011	0.052	1.73	0.577
DEX(SO ₄)	0.960	0.0035	0.054	2.90	0.345

Table S3 Selected chemical properties of the Sadler surface soil

	Na	Ca	Mg	K	Al	Fe	Zn	P
	(mg kg ⁻¹)							
Acid leachable	NA	776	2,223	763	1,809	NA	32	287
Exchangeable	23	766	173	35	37	NM	NM	NM
Mehlich III	NA	841	136	47	907	147	0.3	2.5

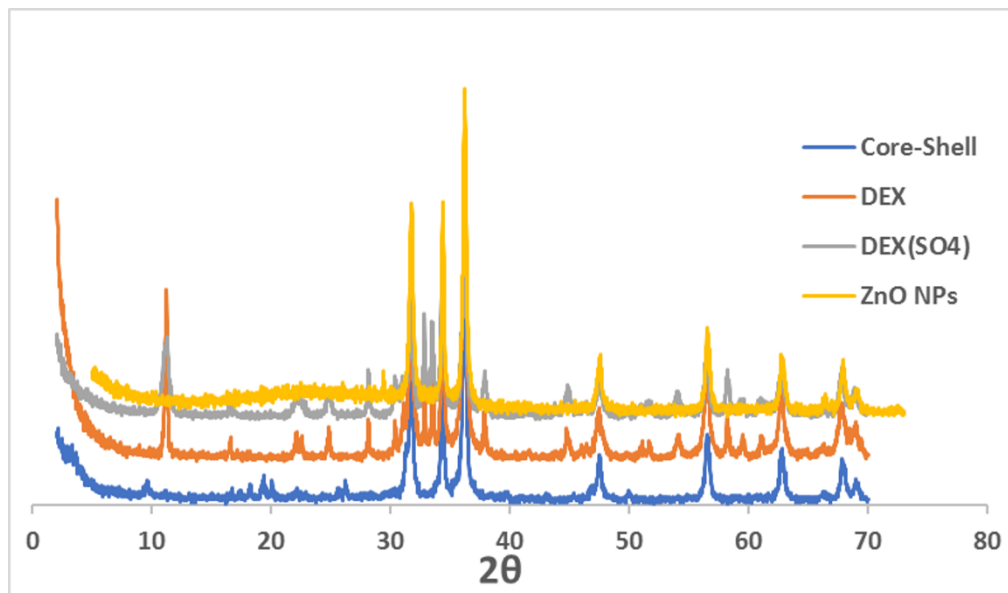
NM: Not measured

NA: Not available

Table S4 Soil solution chemical properties at pH 6 and 8.

Soil pH	Cations (mg L ⁻¹)						Anions (mg L ⁻¹)			IS (M)	DOC (mg C L ⁻¹)
	Na	K	Ca	Mg	Al	Fe	F	Cl	SO ₄		
6	403	508	659	817	4,842	3,870	3	11	27.8	0.9	125
8	350	430	907	1,894	4,364	3,543	7	20	36	1.2	237

Figures

**Fig. S1** X-ray diffractograms of core-shell, DEX, and DEX(SO₄) coated and bare ZnO NPs. Note additional crystal phases present in DEX and DEX(SO₄), likely from crystallized dextran.

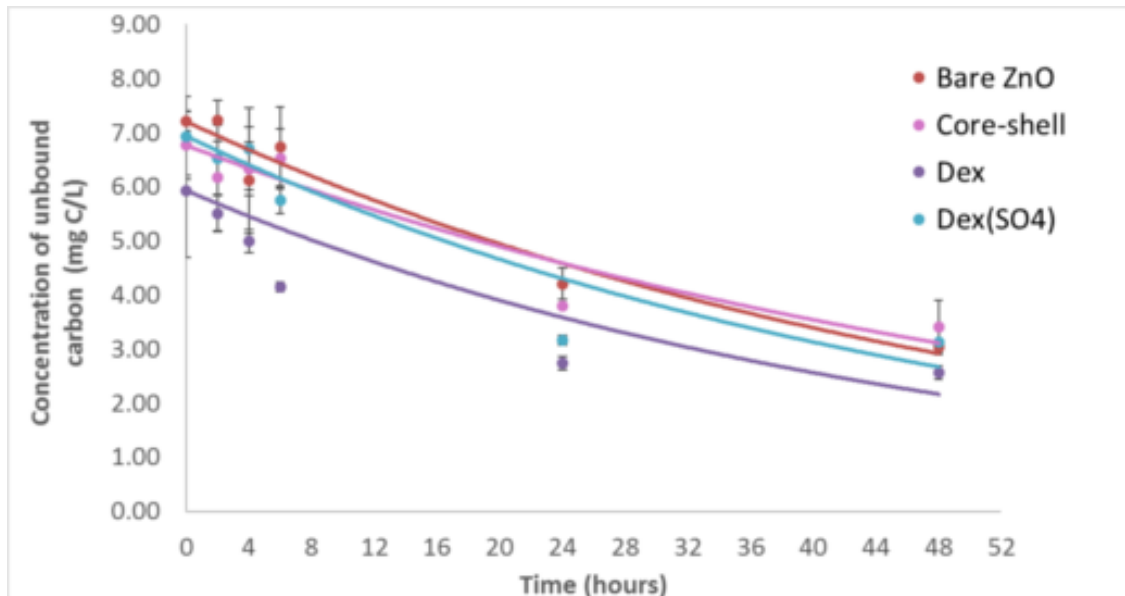


Fig. S2 Equilibrium time reached after 24 h incubation period in batch sorption isotherms experiments, each point is the average of three independent replicates. Error bars represent \pm one standard deviation.

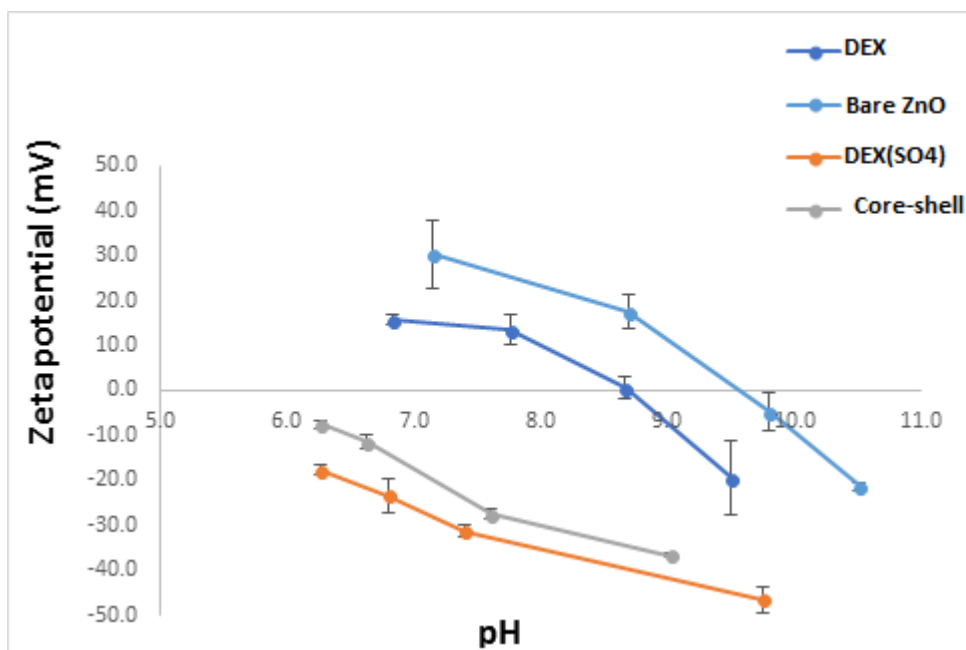


Fig. S3 Electrophoretic mobility of bare ZnO, dextran coated, (DEX-ZnO), ZnO-Zn₃(PO₄)₂ (core-shell), and dextran sulfate coated (DEX(SO₄)-ZnO NPs as a function of pH in deionized (DI) water. Zn concentration was 100 mg L⁻¹ for all the tested suspensions.

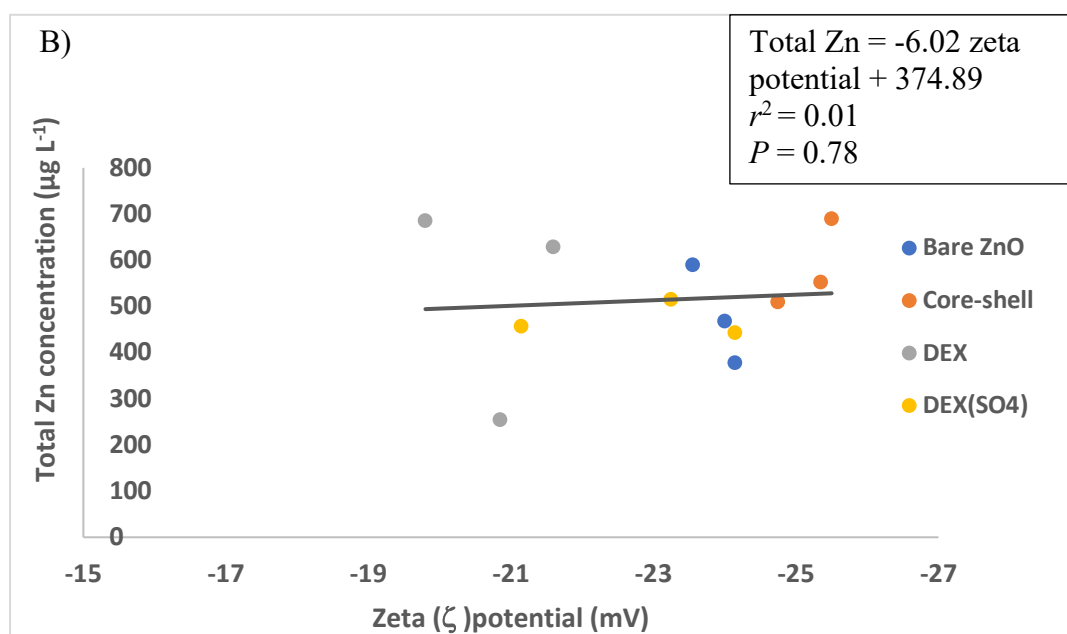
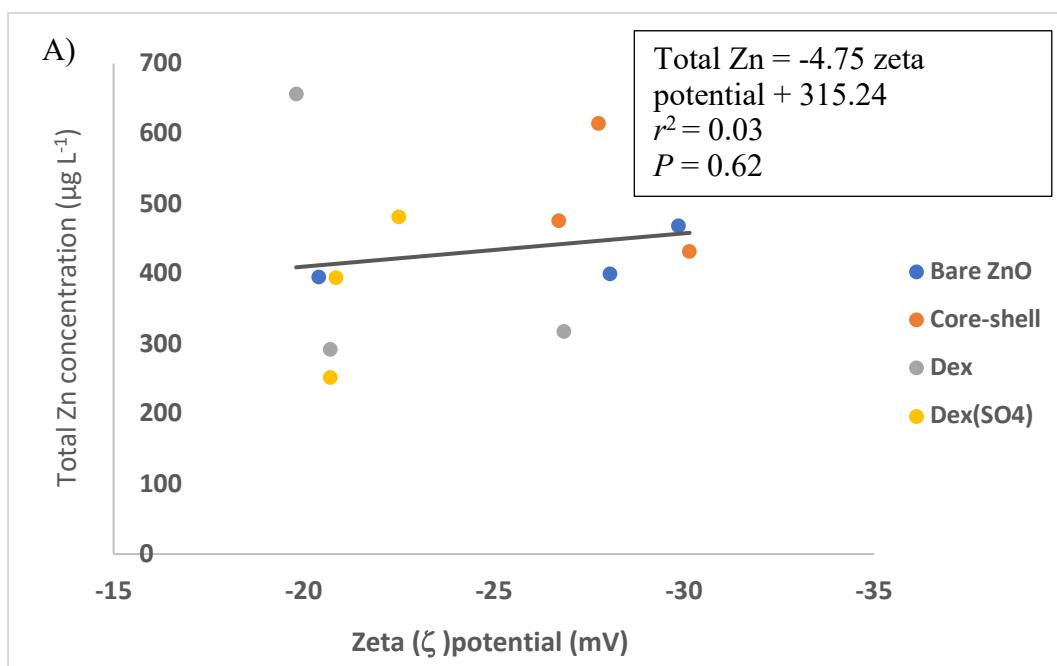


Fig. S4 Linear regression between zeta potential and total Zn in soil solution at pH 6 (A), and pH 8 (B). Inserts: regression equation, r^2 , and significance of the model (p) at $\alpha=0.05$