Electronic Supplementary Material (ESI) for Environmental Science: Nano.

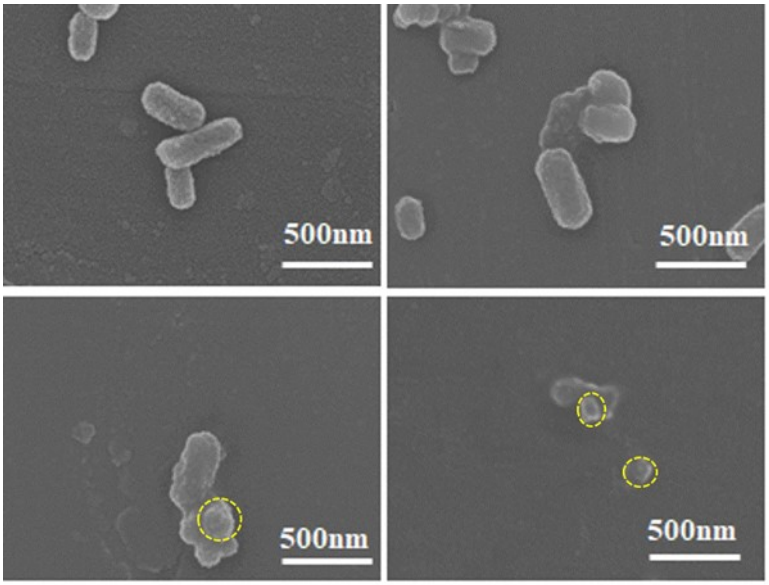
Legends

Figure S1. SEM images of the degradation processes of Pro@Cu-MSNs-ZnO/Hym Nps at pH 5.5 at 0 h (A), 24 h (B), 48 h (C), and 72 h (D).

Figure S2. SEM images of Pro@Cu-MSNs-ZnO/Hym Nps at 72 h under neutral (A) and alkaline conditions (B).

Table S1. The element contents of Pro@Cu-MSNs-NH_2 nanoparticles.

Table S2. Release kinetics parameters of Hym from Pro@Cu-MSNs-ZnO/Hym Nps at different pH values.



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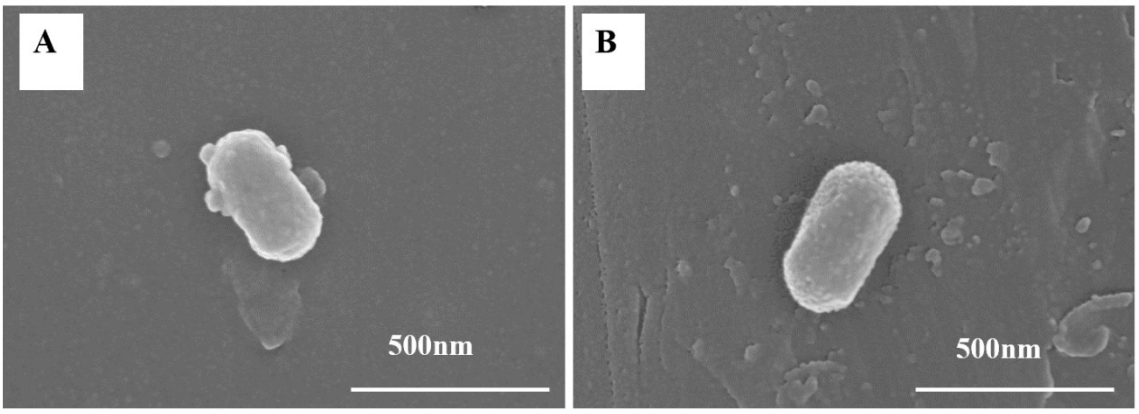

Figure S2. SEM images of Pro@Cu-MSNs-ZnO/Hym Nps at 72 h under neutral (A) and alkaline conditions (B).

Table S1 The element contents of Pro@Cu-MSNs-NH_2 nanoparticles

Element	Weight %	Atomic %
C	41.82	55.84
N	0.09	0.03
O	30.41	29.69
Cu	1.87	0.73
Zn	0.03	0.10
Si	21.97	12.64
Cl	3.81	0.97

Table S2. Release kinetics parameters of Hym from Pro@Cu-MSNs-ZnO/Hym Nps at different pH values.

pH	Fitting Model	Kinetic Equations	R^2
4	Zero-order	$Q = 1.58451t + 57.56172$	0.8858
	First-order	$Q = 86.63206 (1-e^{-0.34927}t)$	0.82615
	Higuchi	$Q = 10.66977\ t^{1/2} + 41.89574$	0.95828
	Ritger- Peppas	$Q = 47.2408t^{0.2128}$	0.98038
5.5	Zero-order	$Q = 1.4297t + 54.04292$	0.85748
	First-order	$Q = 80.75064 (1-e^{-0.59183}t)$	0.92649
	Higuchi	$Q = 9.036\ t^{1/2} + 43.18282$	0.93137
	Ritger- Peppas	$Q = 49.276t^{0.17648}$	0.96402
7	Zero-order	$Q = 2.52894t + 45.34341$	0.68699
	First-order	$Q = 79.97565 (1-e^{-0.53498}t)$	0.9623
	Higuchi	$Q = 14.77464t^{1/2} + 27.54986$	0.85364
	Ritger- Peppas	$Q = 41.00705t^{0.26638}$	0.91737
9	Zero-order	$Q = 4.23678t + 25.78471$	0.77612
	First-order	$Q = 67.34549 (1-e^{-0.56298}t)$	0.98417
	Higuchi	$Q = 19.70406\ t^{1/2} + 9.78218$	0.92963
	Ritger- Peppas	$Q = 29.52958t^{0.38364}$	0.95024