

**Cubic Nano-Silver Decorated Manganese Dioxide Micromotors: Enhanced  
Propulsion and Antibacterial Performance**

Wenjuan Liu<sup>a,b\*</sup>, Hongbin Ge<sup>a</sup>, Xiaoyong Ding<sup>a</sup>, Xiaolong Lu<sup>c\*</sup>, Yanan Zhang<sup>a,b</sup>, Zhongwei Gu<sup>a,b</sup>

<sup>a</sup> College of Materials Science and Engineering, Nanjing Tech University, Nanjing 211816, China

<sup>b</sup> Jiangsu Collaborative Innovation Center for Advanced Inorganic Functional Composites,  
Nanjing Tech University, Nanjing 211816, China

<sup>c</sup> State Key Laboratory of Mechanics and Control of Mechanical Structures, Nanjing University  
of Aeronautics and Astronautics, Nanjing 210016, China

Corresponding authors: Wenjuan Liu: [liuwenjuan@njtech.edu.cn](mailto:liuwenjuan@njtech.edu.cn)

Xiaolong Lu: [long\\_8446110@nuaa.edu.cn](mailto:long_8446110@nuaa.edu.cn)

Video S1: PEDOT/MnO<sub>2</sub>@Ag and PEDOT/MnO<sub>2</sub> micromotors in various concentrations of H<sub>2</sub>O<sub>2</sub> solution

Video S2: PEDOT/MnO<sub>2</sub>@Ag micromotors in low concentration of H<sub>2</sub>O<sub>2</sub>

Video S3: PEDOT/MnO<sub>2</sub>@Ag micromotors with different co-deposition time

Video S4: PEDOT/MnO<sub>2</sub>@Ag micromotors with lower ratio of Ag deposition in various concentrations of H<sub>2</sub>O<sub>2</sub> solutions

Video S5: PEDOT/MnO<sub>2</sub>@Ag micromotors in various surfactants

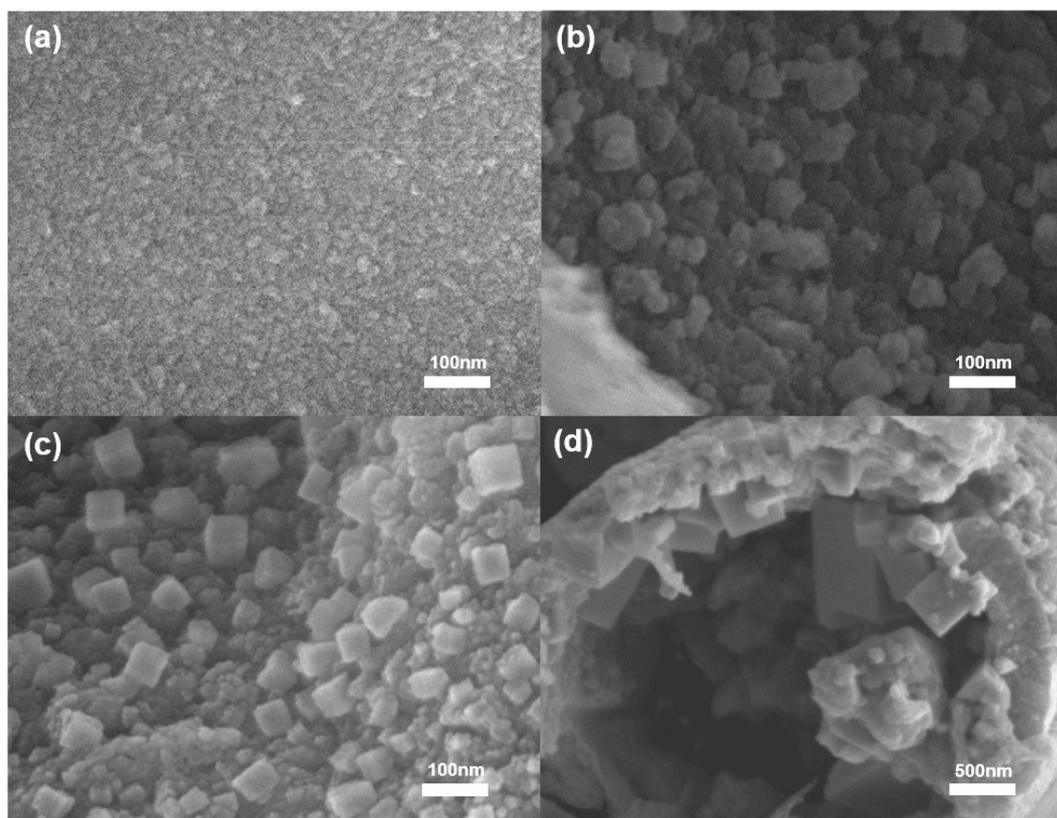


Figure S1. Characterization of PEODT/MnO<sub>2</sub> and PEODT/MnO<sub>2</sub>@Ag micromotors. SEM images of the inner surface from a PEODT/MnO<sub>2</sub> microtube (a), single PEODT/MnO<sub>2</sub>@Ag micromotor, deposition time is 250 seconds, 500 seconds and 750 seconds, respectively (b-d).

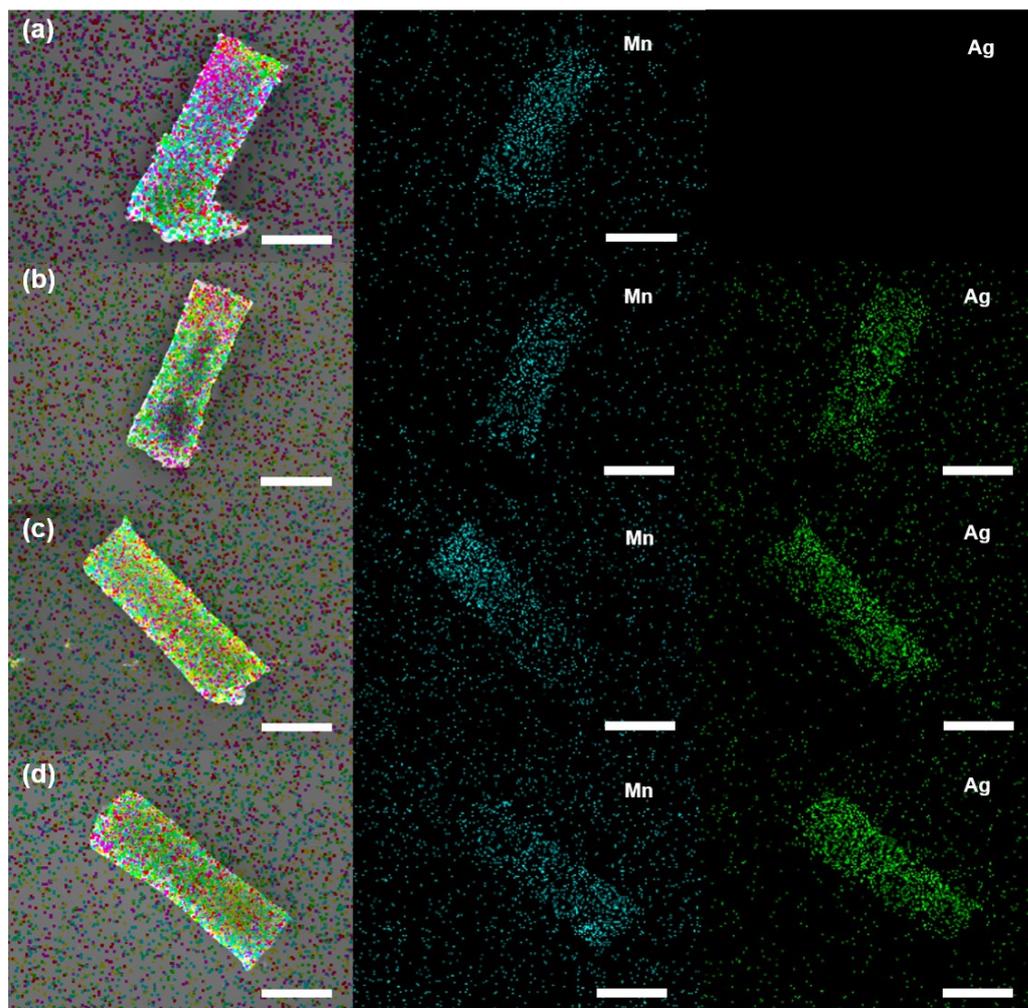


Figure S2. EDX mapping images of element Mn (aquamarine) and Ag (green) within both PEODT/MnO<sub>2</sub> (a) and PEODT/MnO<sub>2</sub>@Ag micromotors with different co-deposition time (b-d). Scale bar: 5  $\mu$ m.

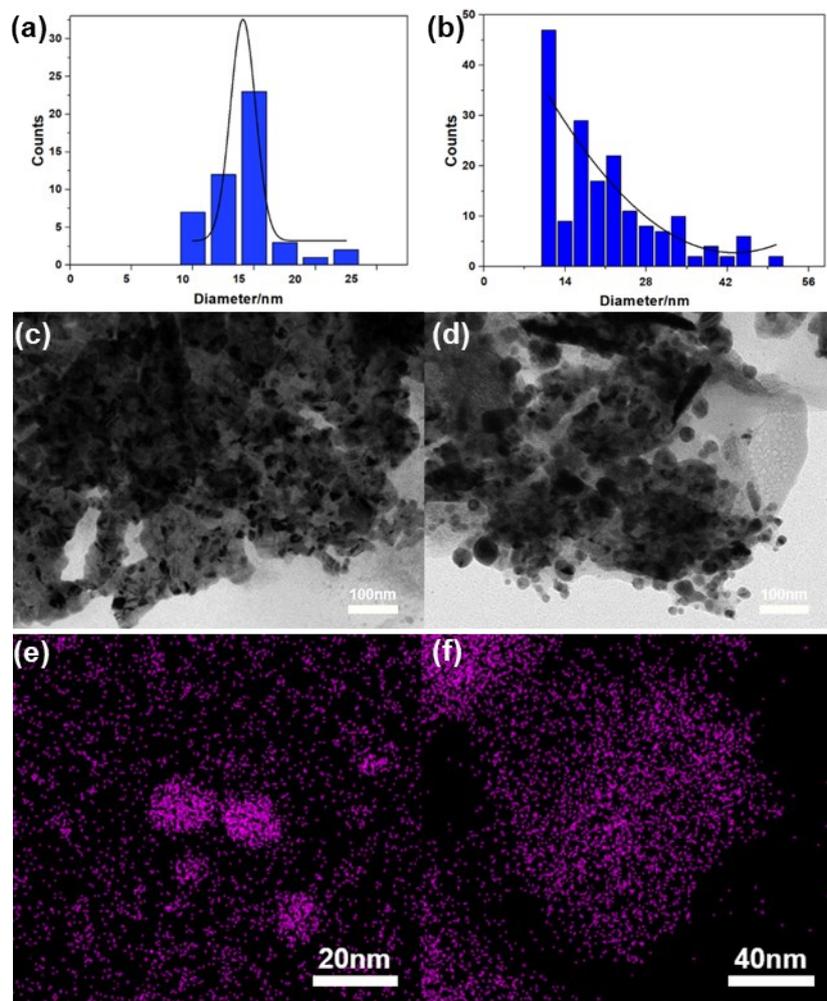


Figure S3. Size and distribution of nanoparticles in the inner surface of PEODT/MnO<sub>2</sub>@Ag micromotors with different co-deposition time (a, b). TEM images of nanoparticles and EDX mapping images of element Ag in the inner surface of PEODT/MnO<sub>2</sub>@Ag micromotors (c-f). (The deposition time in left column is 250 seconds. The deposition time in right column is 750 seconds.)

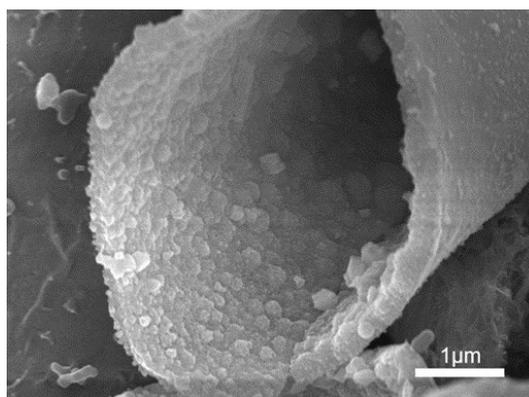


Figure S4. SEM image of inner surface from PEODT/MnO<sub>2</sub>@Ag micromotors with low ratio of Ag deposition (reduced by half Ag concentration in plating solution).

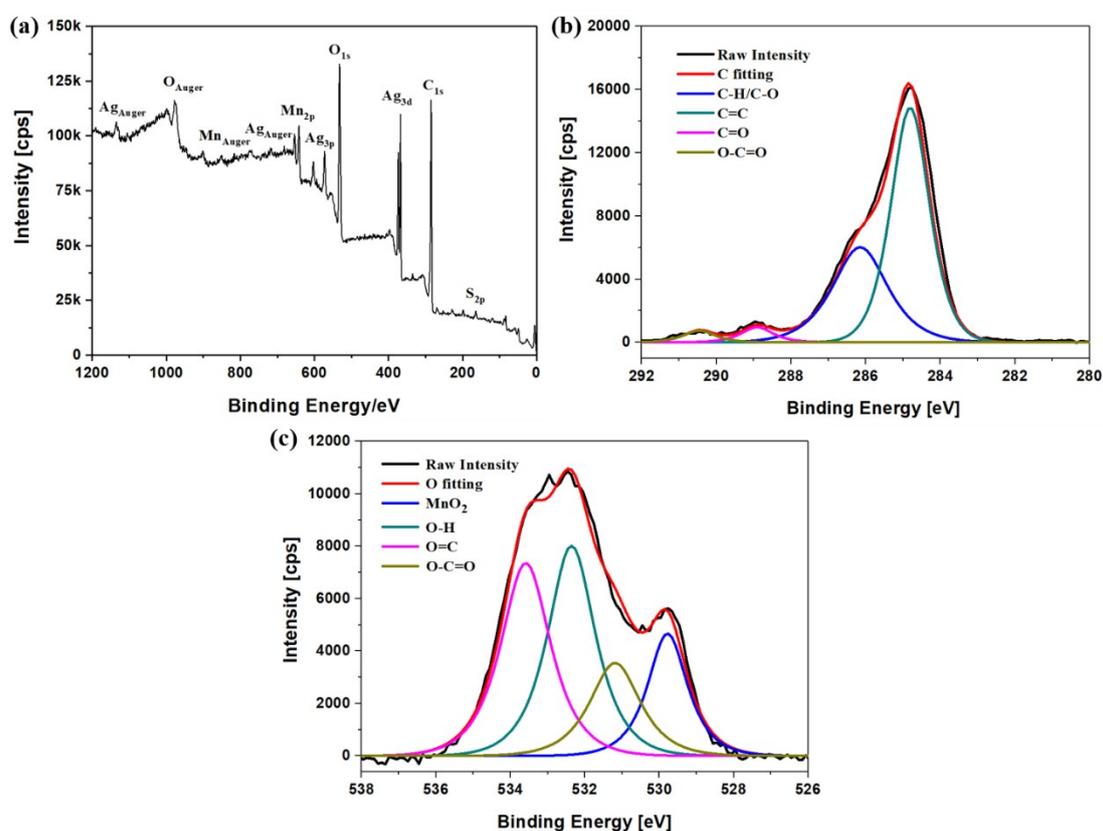


Figure S5. XPS survey of PEODT/MnO<sub>2</sub>@Ag micromotors. XPS spectra of wide scan for PEODT/MnO<sub>2</sub>@Ag micromotors (a). High-resolution C 1s XPS spectra and fitting peaks (b), High-resolution O 1s XPS spectra and fitting peaks (c), displaying various functional groups identified on the surface of the micromotors.

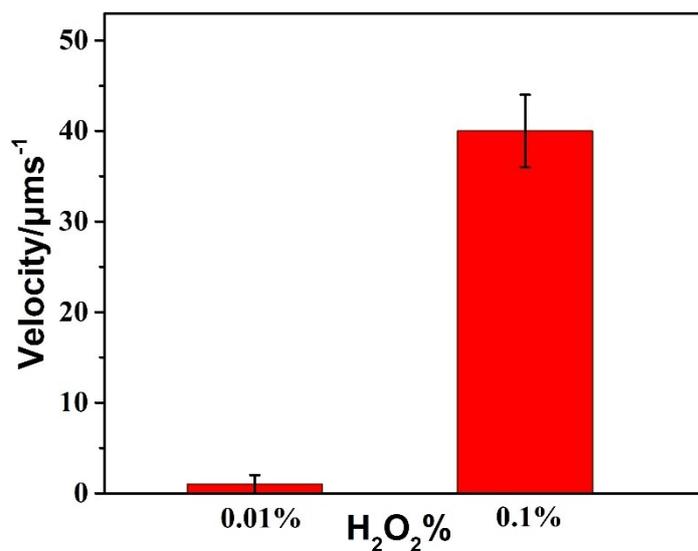


Figure S6. Velocity of PEDOT/MnO<sub>2</sub>@Ag micromotors with 500 s deposition in low concentration of H<sub>2</sub>O<sub>2</sub> (c). All experiments were carried out at 0.167% v/v Triton-X100.

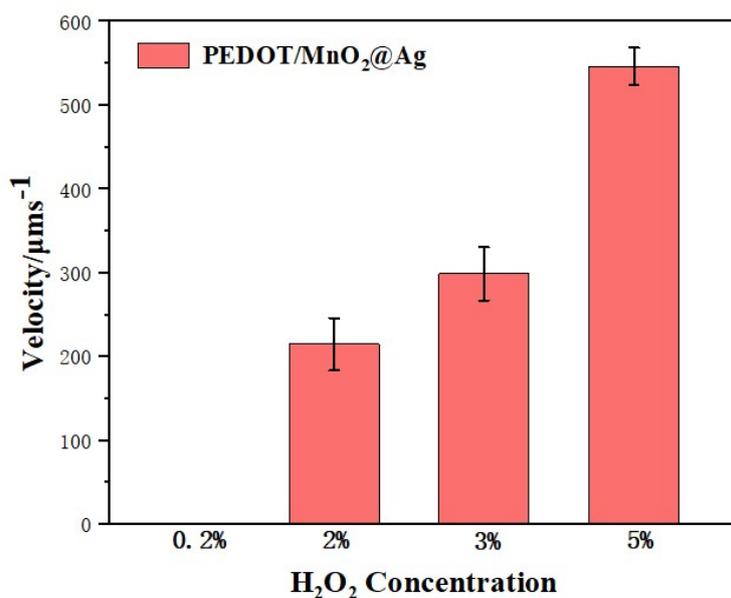


Figure S7. Velocity of PEDOT/MnO<sub>2</sub>@Ag micromotors with low ratio of Ag deposition (reduced by half Ag concentration in plating solution) in different H<sub>2</sub>O<sub>2</sub> concentrations.

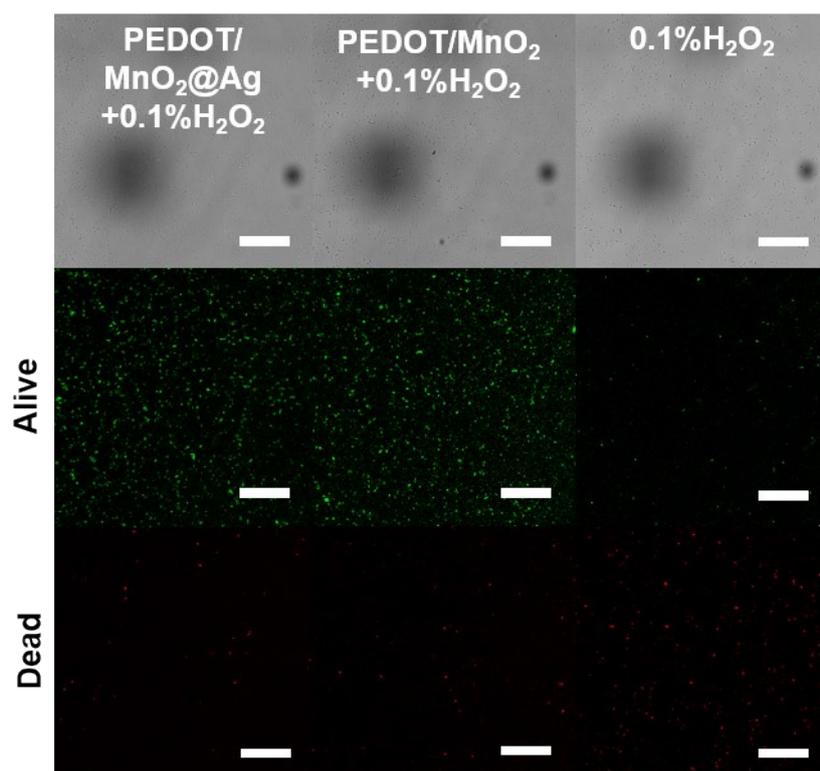


Figure S8. Bactericidal assay results using PEDOT/MnO<sub>2</sub>@Ag and hydrogen peroxide. Optical and imposed fluorescence microscope images of bacteria using fluorescence lamp after the bactericidal assay for PEDOT/MnO<sub>2</sub>@Ag micromotors and 0.1% H<sub>2</sub>O<sub>2</sub> (left column), PEDOT/MnO<sub>2</sub>@Ag micromotors and 0.1% H<sub>2</sub>O<sub>2</sub> (middle column), and only 0.1% H<sub>2</sub>O<sub>2</sub> solution (right column). (scale bar: 25 μm). All experiments were carried out at 0.167% v/v Triton-X100.

Table S1. The chemical composition of four types of micromotors.

Time	C (wt%)	O (wt%)	S (wt%)	Mn (wt%)	Ag (wt%)
0 s	42.64	38.97	4.35	14.04	-
250 s	33.20	38.79	2.80	9.23	15.99
500 s	32.92	34.43	2.94	12.71	17.50
750 s	23.97	36.18	3.63	12.42	23.79
500 s with less Ag	34.81	40.84	1.65	17.00	5.70