Drug-free enzyme-based bactericidal nanomotors against pathogenic bacteria

Diana Vilela,[‡†] Nuria Blanco-Cabra,[§] Ander Eguskiza,[‡] Ana C. Hortelao,[‡]*

*Eduard Torrents[§£] and Samuel Sanchez[‡¥]**

‡ Smart nano-bio-devices. Institute for Bioengineering of Catalonia (IBEC), The Barcelona Institute of Science and Technology (BIST). Baldiri Reixac 10-12, 08028 Barcelona Spain.

§ Bacterial infections: antimicrobial therapies. Institute for Bioengineering of Catalonia (IBEC), The Barcelona Institute of Science and Technology (BIST) Baldiri Reixac 10-12, 08028 Barcelona Spain.

£ Microbiology Section, Department of Genetics, Microbiology and Statistics Faculty of Biology. University of Barcelona 643 Diagonal Ave., 08028, Barcelona, Spain.

¥ Institució Catalana de Recerca i Estudis Avancats (ICREA). Pg. Lluís Companys 23, 08010, Barcelona, Spain

* E-mail: divilela@ucm.es and ssanchez@ibecbarcelona.eu

KEYWORDS

Enzymatic nanomotors • biofilms • *E. coli* • infections • nanomachines • self-propulsion

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incubation with *E. coli* strain MG1655. (A) Fluorescence images of dead (red) and live (green) bacteria after 1h of incubation of $1x10^8$ CFU/mL of *E. coli* with NH_4^+ and HCO_3^- (scale bars = 50 μm). (B) Percentage of dead bacteria as calculated from the fluorescence images in A (N=3, error bars represent SE).

Figure S4. Evaluation of lysozyme activity: live bacteria obtained from live-dead assay after 2 hours of incubation of (A) lysozyme with *M. lysodeikticus* (0.1 mg/mL), (B) lysozyme with *E. coli,* and (C) L-MSNPs with *E. coli*.

Figure S5. Percentage of dead bacteria obtained from a live-dead assay after 2 hours of $1x10^8$ CFU/mL *E. coli* treated with 12.5 μg/mL (minimum inhibitory concentration, MIC_{50}).

Figure S6. Images corresponding to the live/dead assay for the protein-modified MSNPs and controls after 2 hours of treatment.

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Figure S9. Photograph of petri plates at 10^3 CFU dilution used to measure the effect of urease, U-MSNPs, L-MSNPs, and M-MSNPs against *E. coli* after 4 hours.

Video S1. U-MSNP nanomotors in LB at 0 mM and 100 mM urea concentrations.

Video S2. U-MSNP nanomotors in PBS at 0mM and 100 mM urea concentrations.

Video S3. U-MSNP nanomotors in simulated urine at 0mM and100 mM urea concentrations.

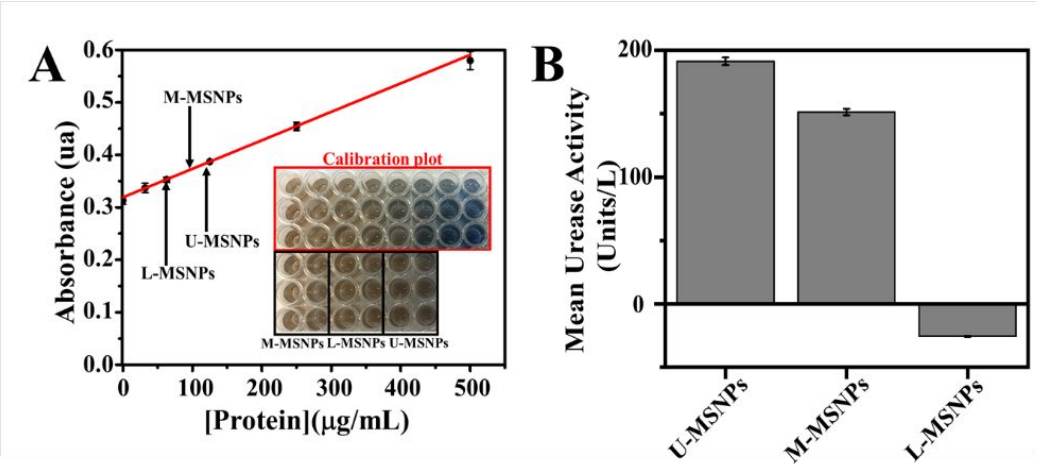


Figure S1. Characterization of enzyme-based mesoporous silica nanoparticles. (A) Calibration plot and amount of protein bonded to each type of MSNP (1mg/mL) for absorbance of 0.319 + 5.43×10^{-4}[Protein] and a protein concentration range of 2.5-500 μg/mL the slight blue tinge in some samples were obtained once Coomassie brilliant blue G had reacted with the proteins in each sample. (B) Enzymatic activity of urease bound to three different types of MSNP (N=3, error bars indicate SE).

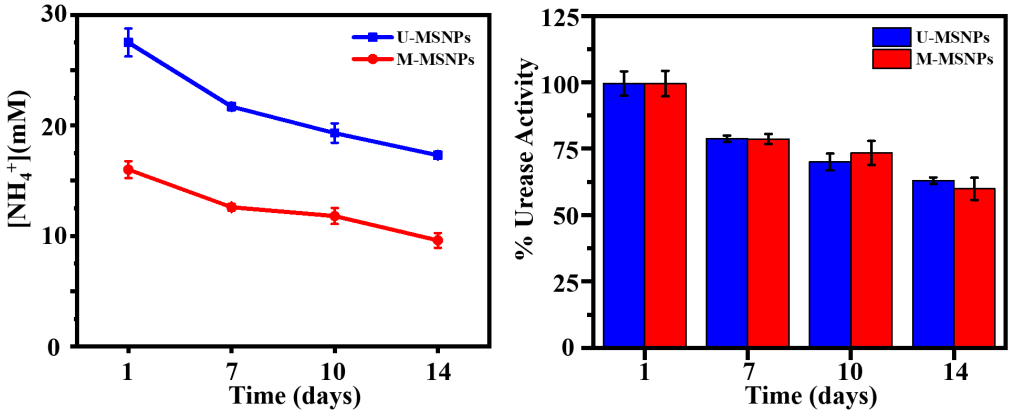


Figure S2. Enzyme activity of U-MSNPs and M-MSNPs during 14 days of storage at 4ºC in PBS with pH 7.4.

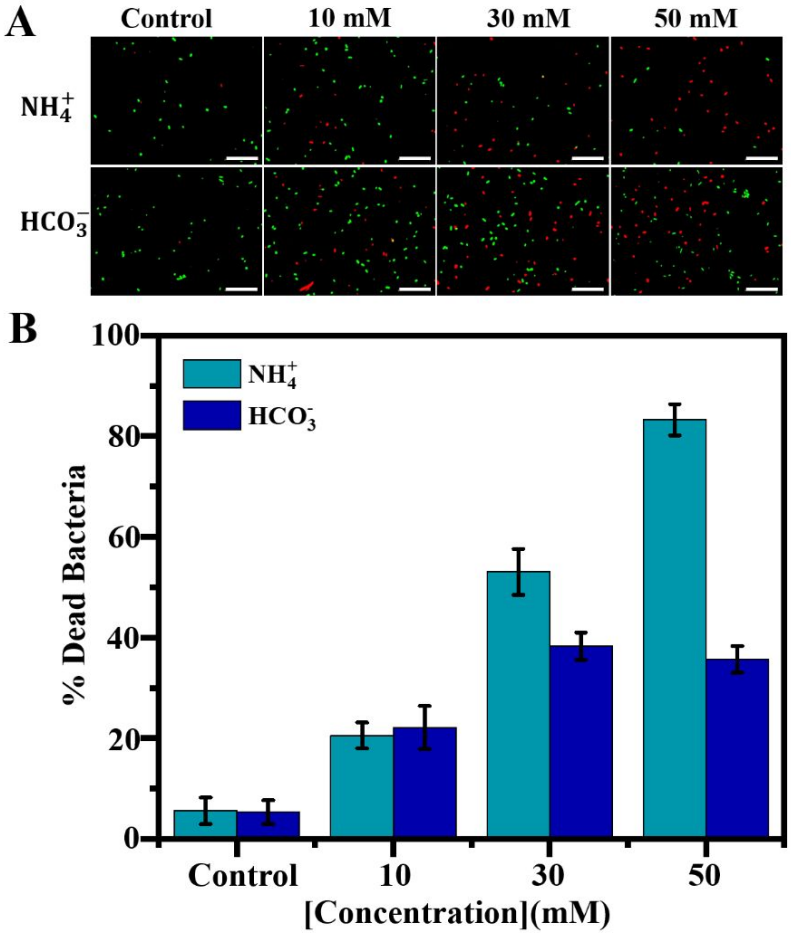
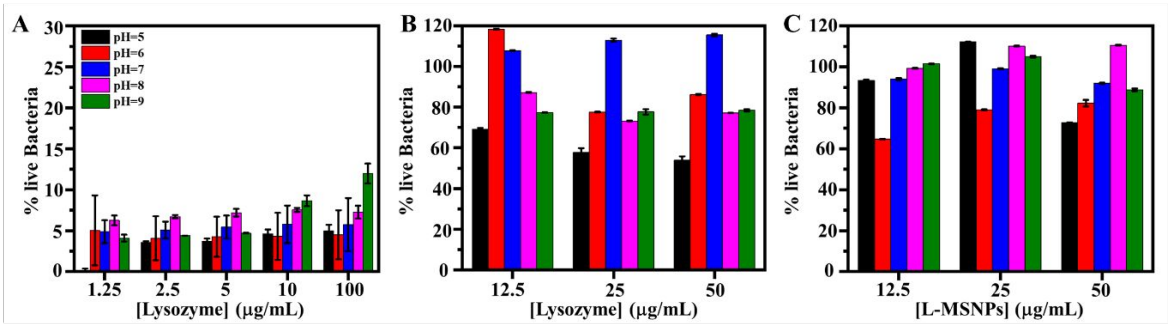


Figure S3. Evaluating the bactericidal efficacy of different concentrations (0-50 mM) of the urease enzymatic products NH_4^+ and HCO_3^- after 1 hour of incubation with *E. coli* strain MG1655. (A) Fluorescence images of dead (red) and live (green) bacteria after 1h of incubation of $1x10^8$ CFU/mL of *E. coli* with NH_4^+ and HCO_3^- (scale bars = 50 μm). (B) Percentage of dead bacteria as calculated from the fluorescence images in A (N=3, error bars represent SE).



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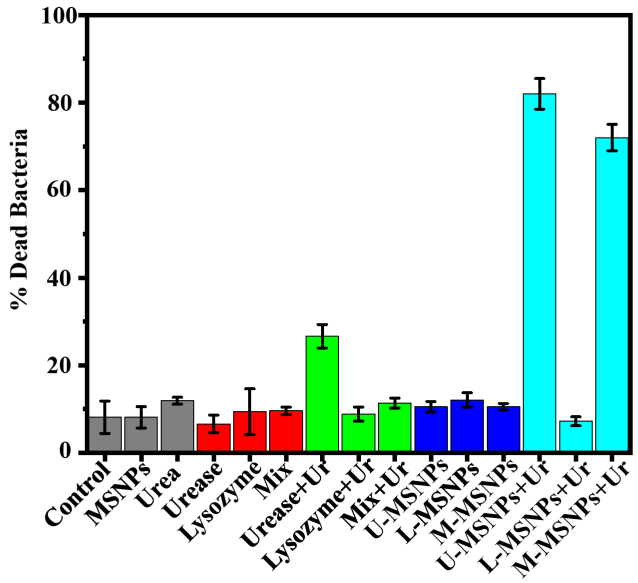

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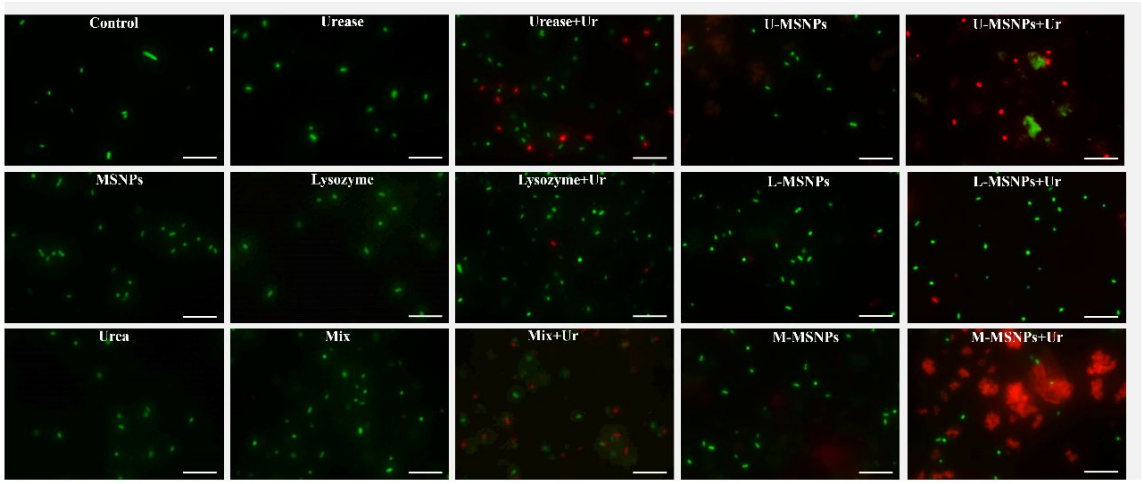

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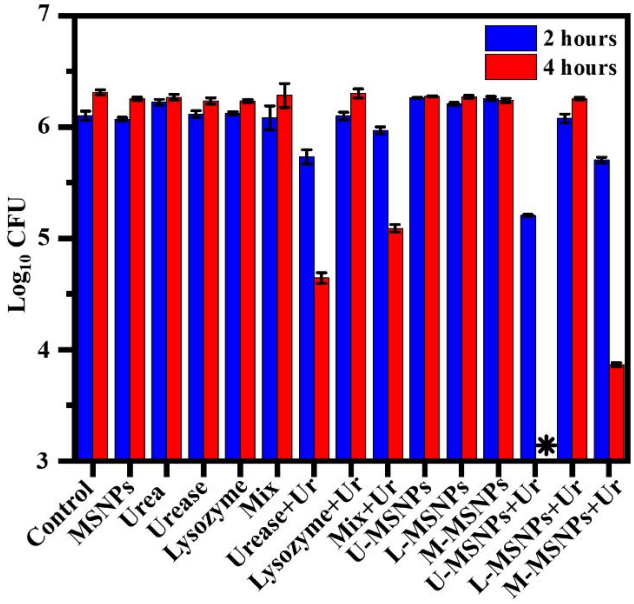

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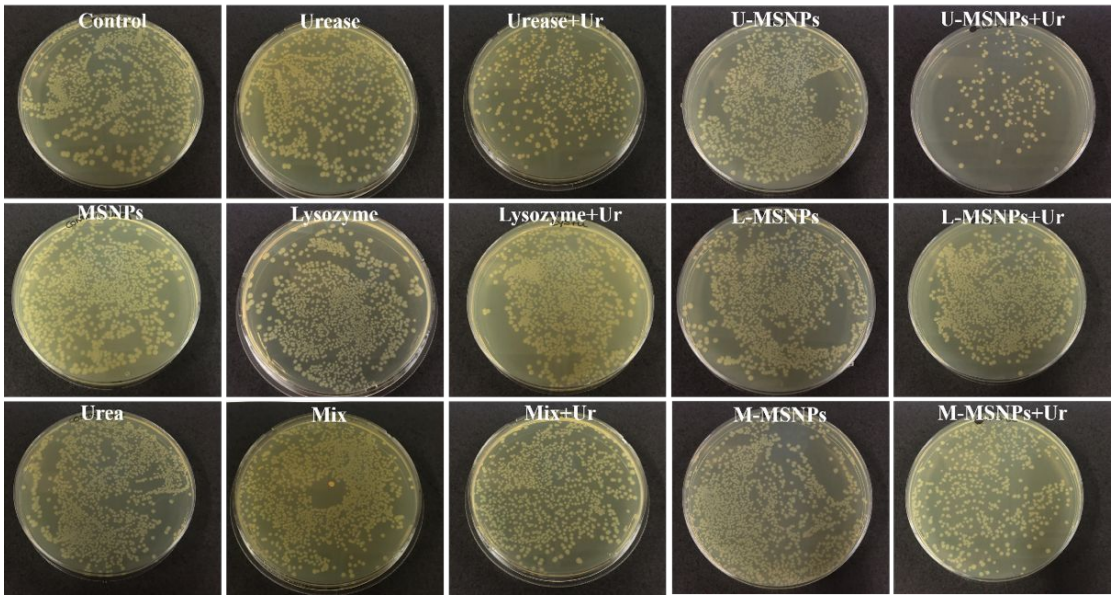

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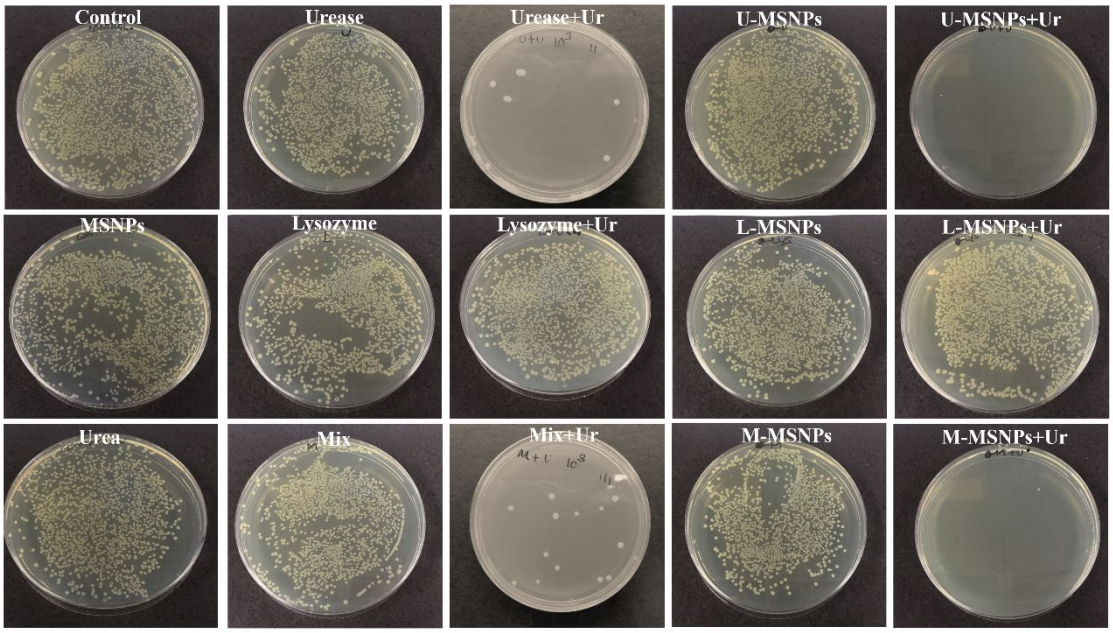

Figure S9. Photograph of petri plates at 10^3 CFU dilution used to measure the effect of urease, U-MSNPs, L-MSNPs, and M-MSNPs against *E. coli* after 4 hours.

AUTHOR INFORMATION

Corresponding Author

*E-mail: ssanchez@ibecbarcelona.eu, divilela@ucm.es

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