

Supplementary information for

Wei Song, Zhongxin Liu, Jia Xu, Zhihong Wang, Guixing Zhou, Jianfeng Wang, Quan Zhou, Kaiting Zhao, Ayesha Younas, Shuanghu Wang, Yong Shi, 2026. Dual-targeting by rotating magnetic field-driven superparamagnetic bionic nanorobots for enhanced triple-negative breast cancer therapy. *Bio-Des Manuf*, 9(5):825-844. <https://doi.org/10.1631/bdm.2500656>



Fig. S1 MFDNs comparative figure after magnetic field adsorption.

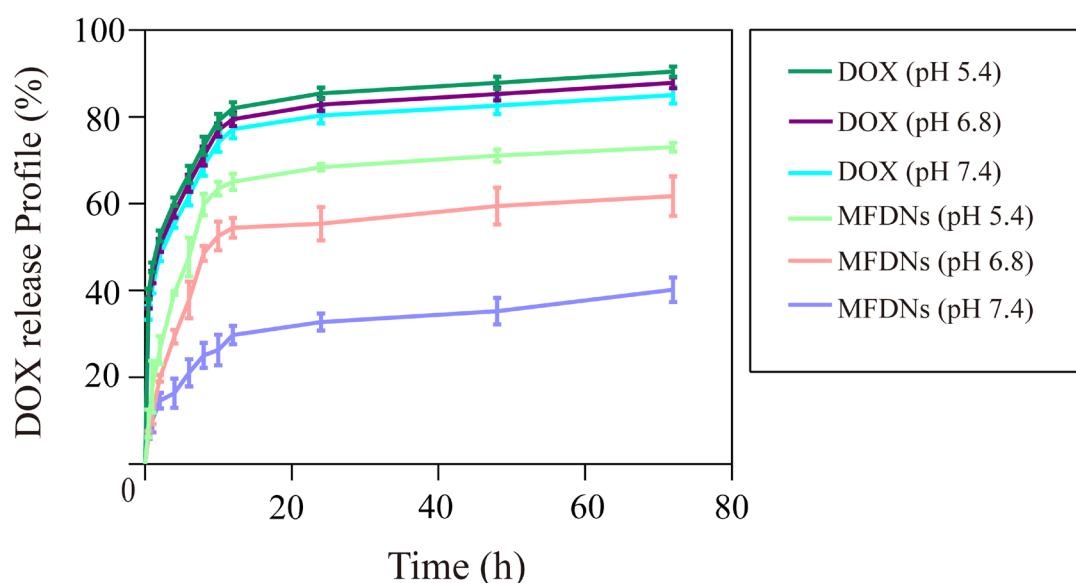


Fig. S2 In vitro DOX release profiles of free DOX and MFDNs at pH 5.4, 6.8, and 7.4 (mean $\pm$ standard deviation, $n=3$).

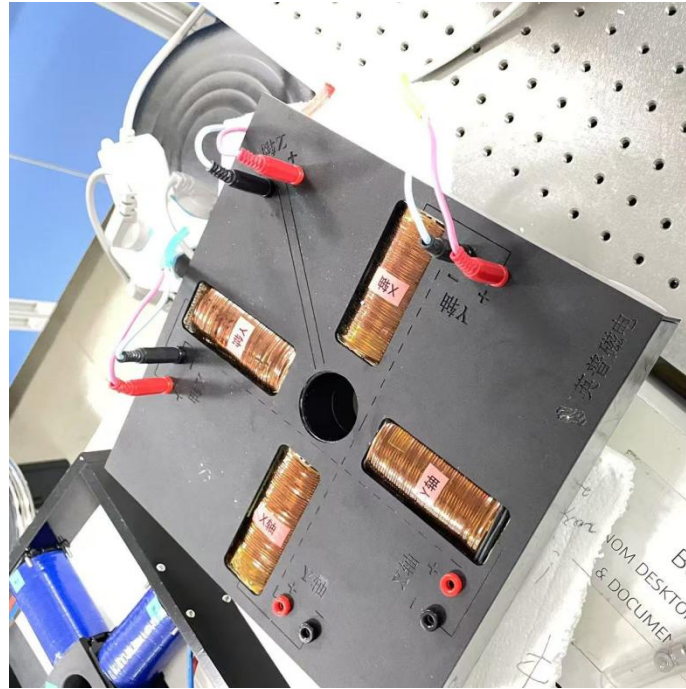


Fig. S3 Photograph of the custom five-coil electromagnetic actuator used to generate the rotating magnetic field.

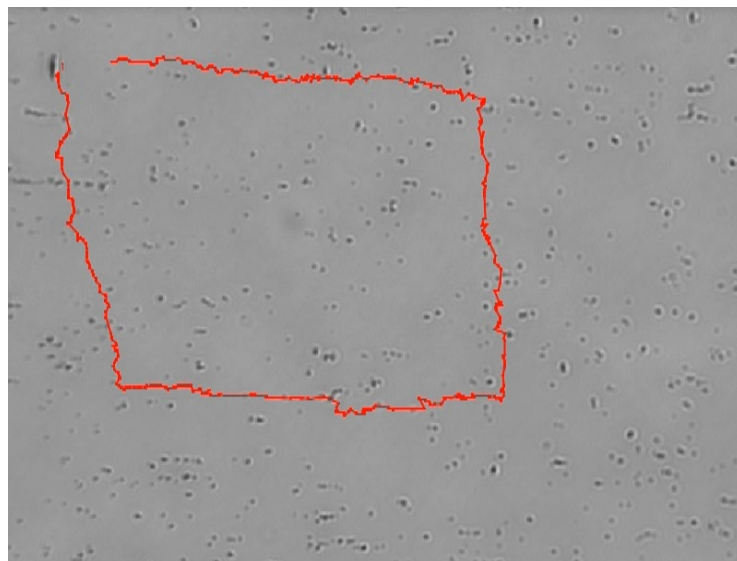


Fig. S4 The rectangular trajectory of MFDNs achieved by adjusting the magnetic field. The trajectory was generated by sequentially adjusting the direction of a rotating magnetic field (frequency: 5 Hz, field strength: 100 mT) over a total duration of approximately 130 s.

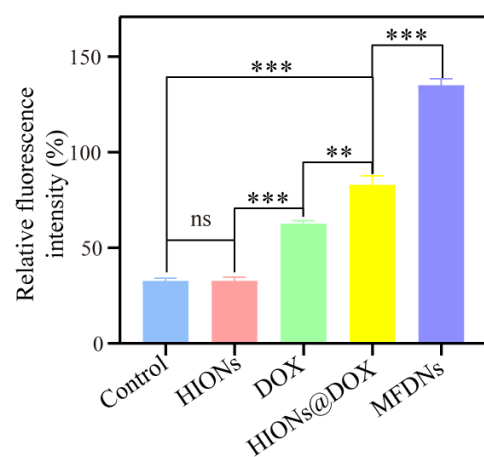


Fig. S5 Quantitative analysis of fluorescence intensity of ROS staining in 4T1 cells treated with different formulations (mean $\pm$ standard deviation, $n=3$).