

## Supplementary Information

### **Pick up and dispose of pollutants from water via temperature-responsive micellar copolymers on magnetite nanorobots**

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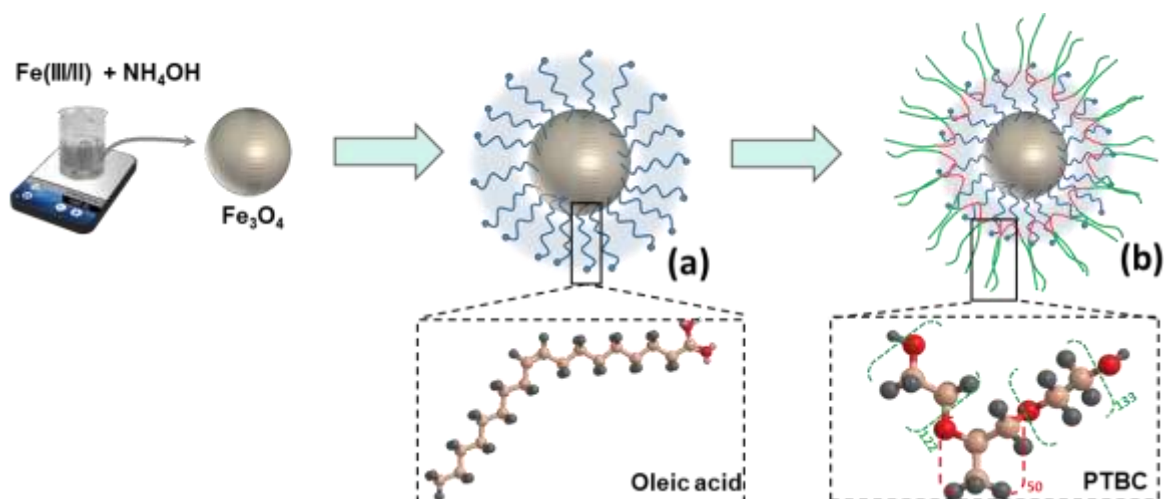
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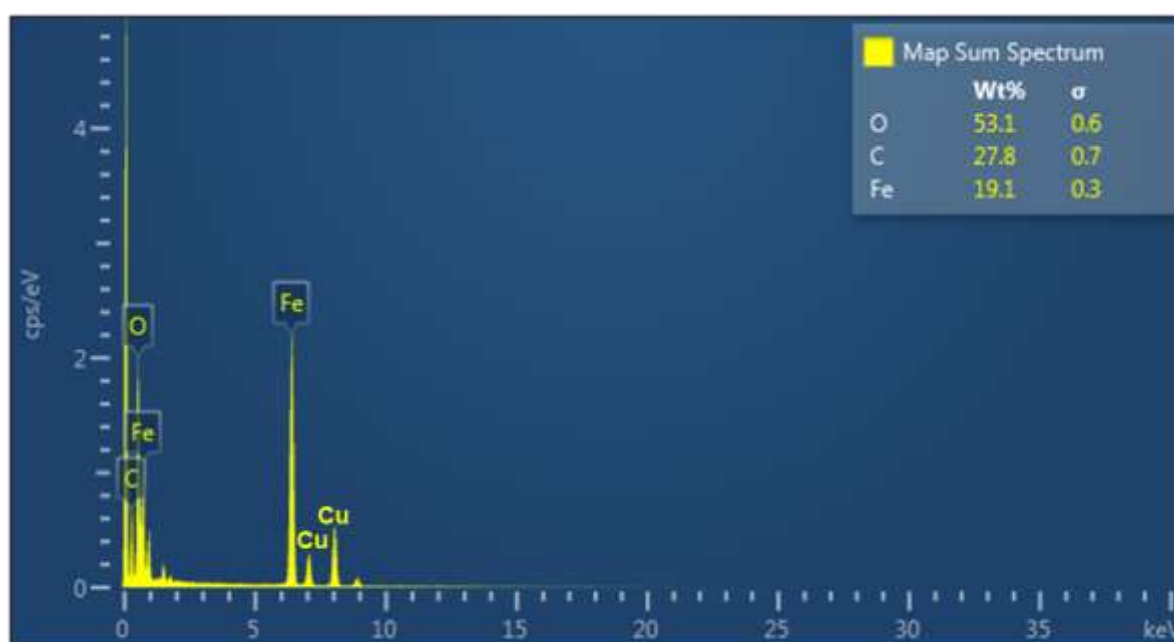
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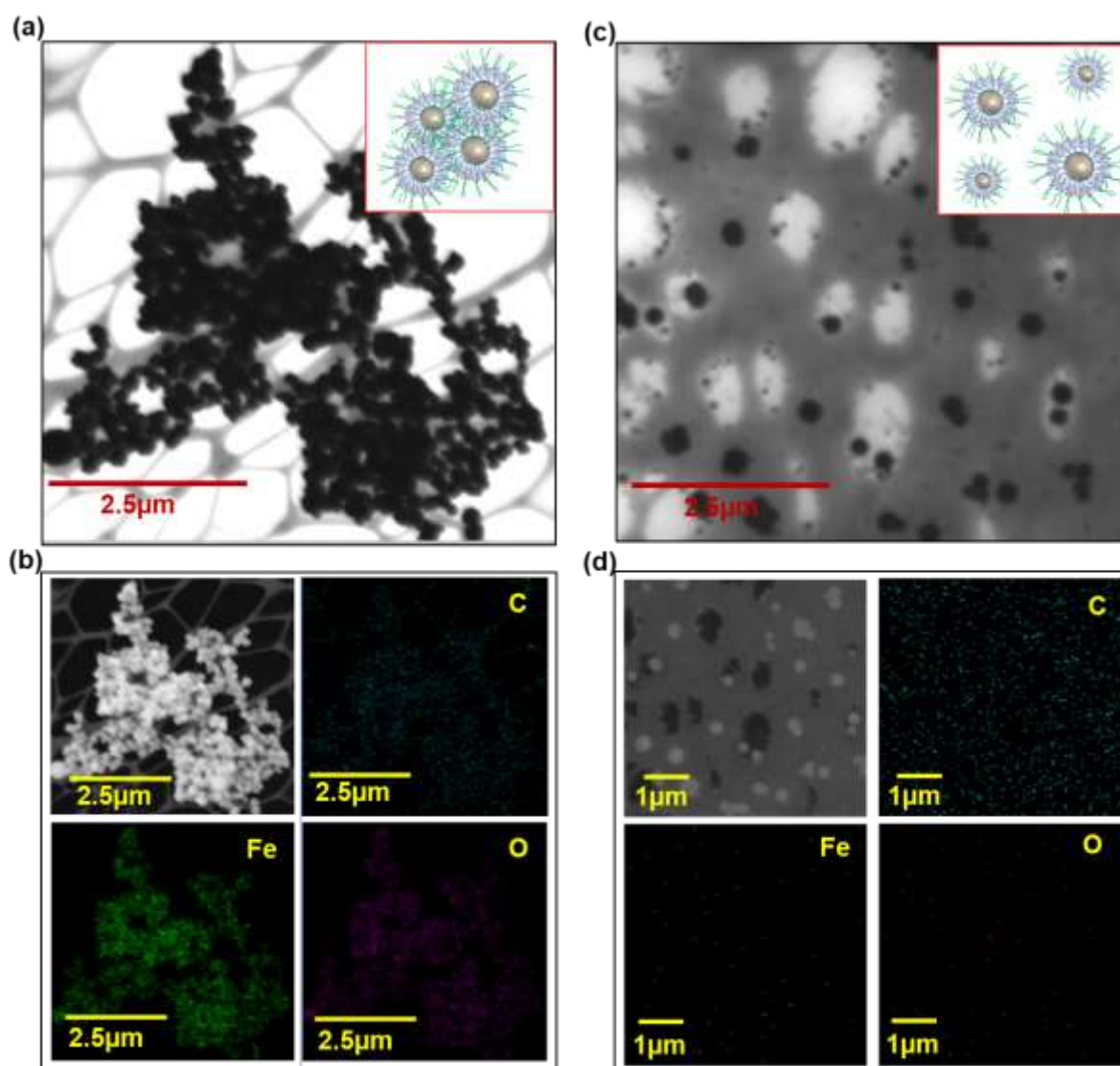
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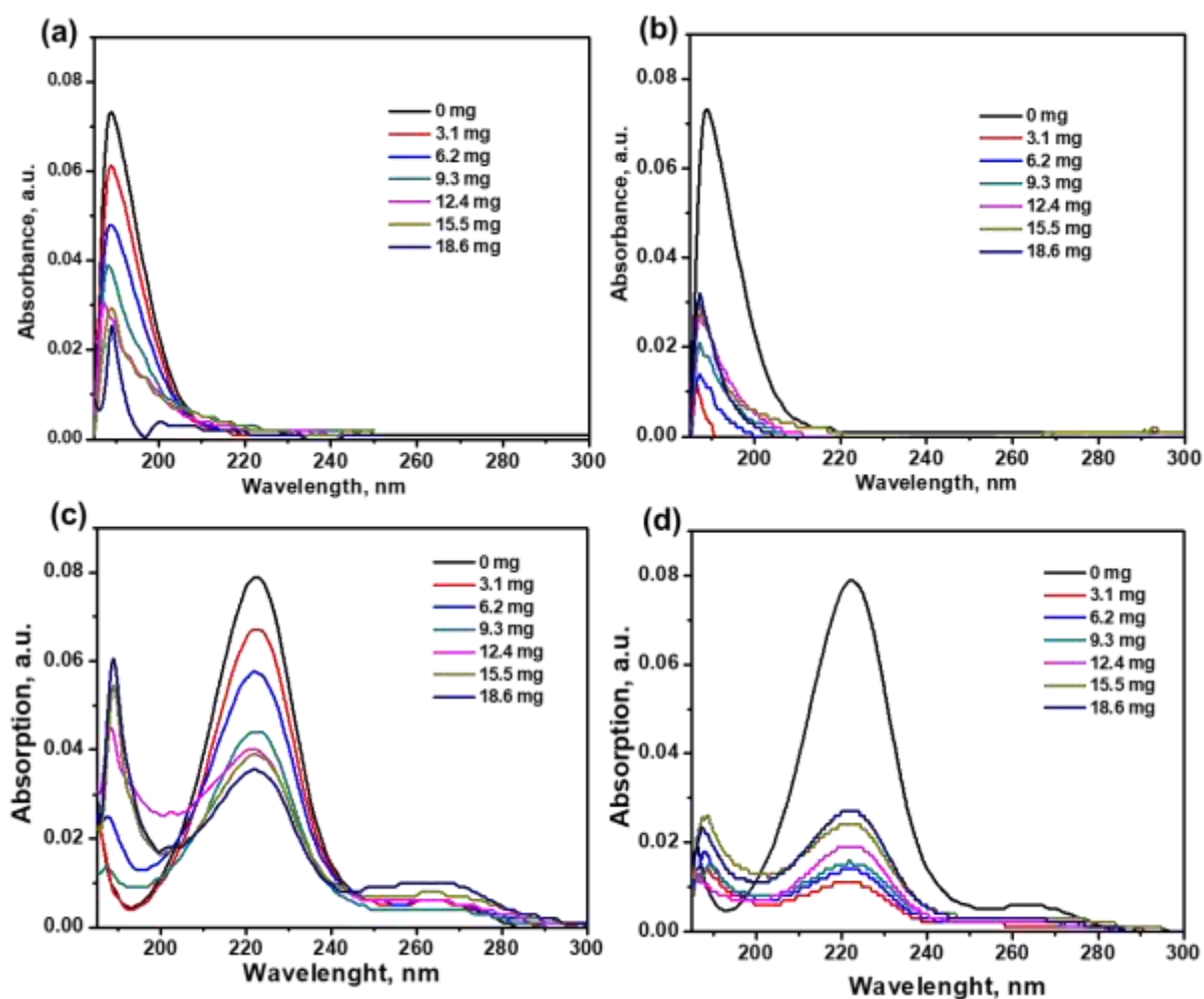
**Supplementary Figure 1:** Synthesis of TM nanorobots. (a) oleic acid functionalization on  $\text{Fe}_3\text{O}_4$  nanoparticles and (b) PTBC decorated on oleic acid@ $\text{Fe}_3\text{O}_4$  nanoparticles.



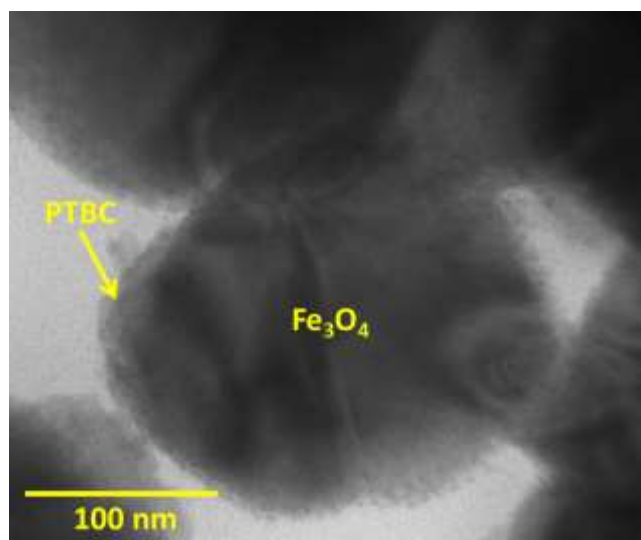
**Supplementary Figure 2:** EDS spectrum of TM nanorobots. Note that the copper peak in the spectrum arises from the sample support STEM grid.



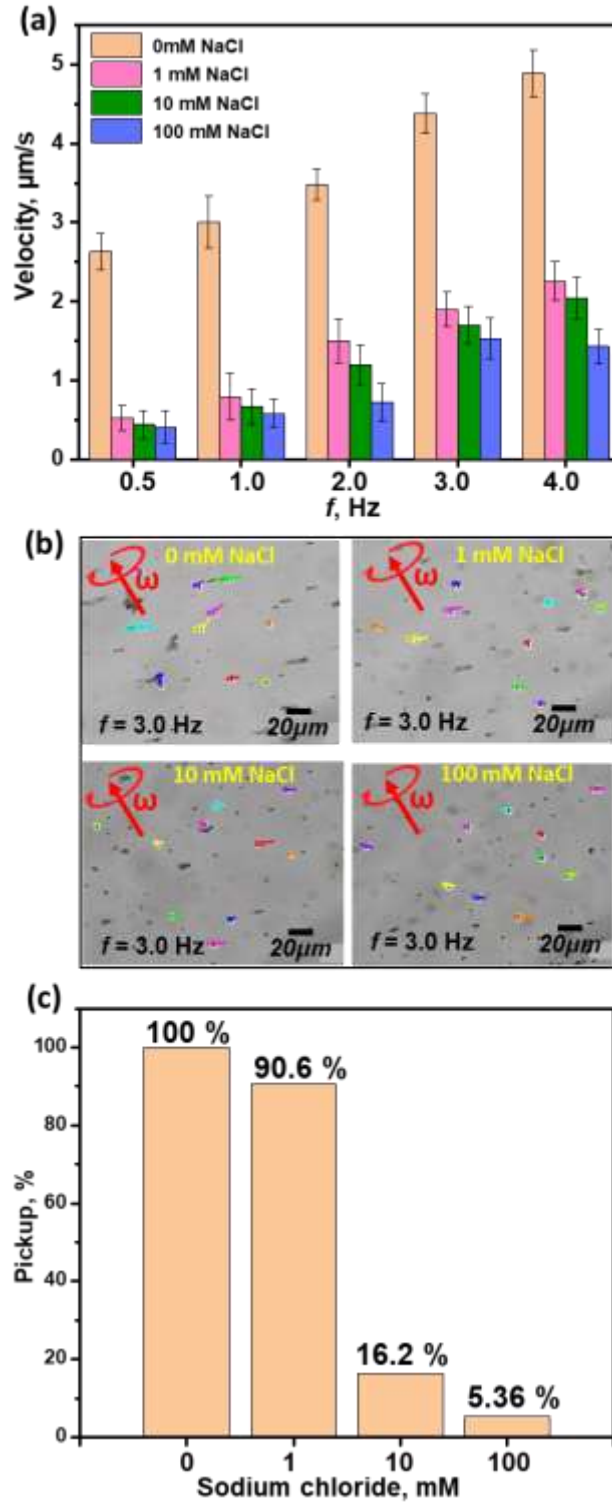
**Supplementary Figure 3:** TM nanorobot morphology study as a function of temperatures; (a, b) STEM image, EDS mapping of TM nanorobots prepared at 25 °C, (c, d) STEM image, EDS mapping of TM nanorobots prepared at 5 °C.



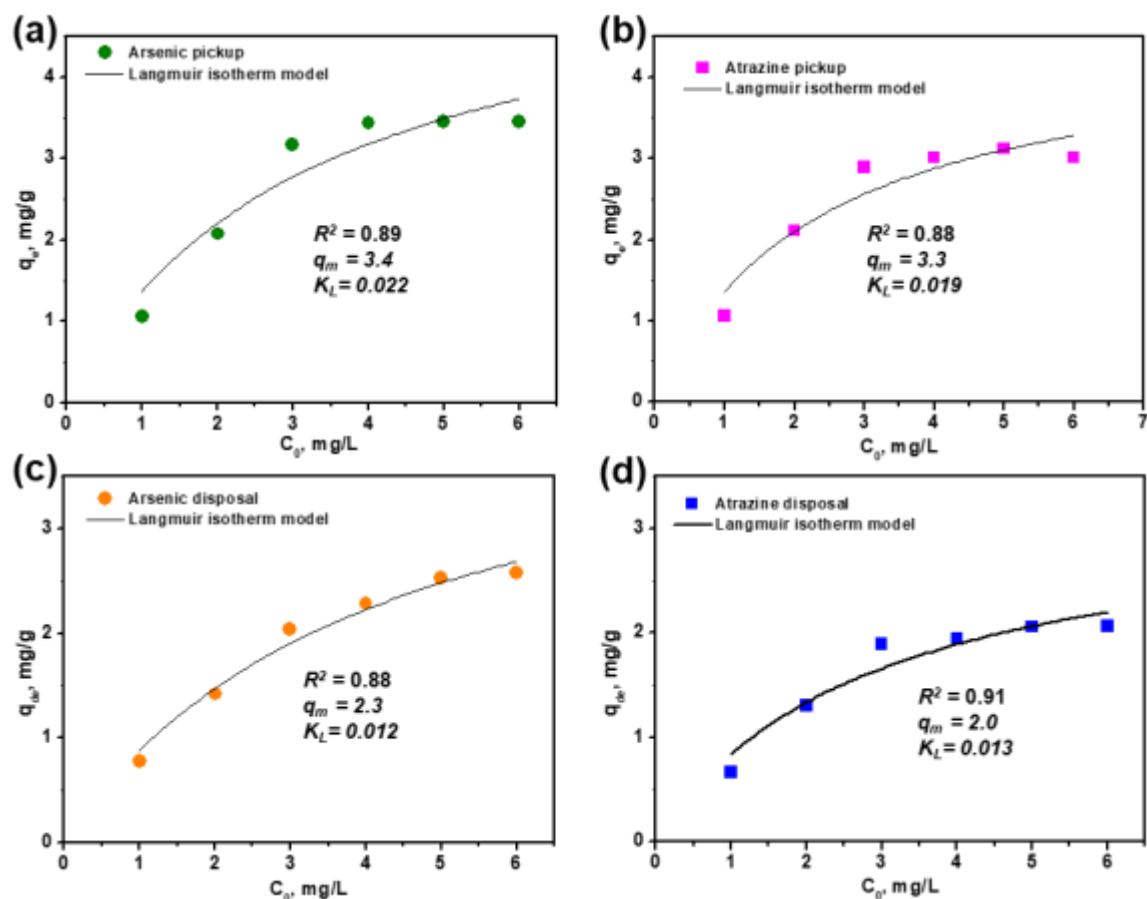
**Supplementary Figure 4:** Absorbance spectrum of pollutants. (a) Pickup and (b) dispose arsenic ions at different concentration of TM nanorobots. (c) Pickup and (d) dispose atrazine at different concentration of TM nanorobots.



**Supplementary Figure 5:** TEM image after ten cycles of arsenic removal by TM nanorobots.



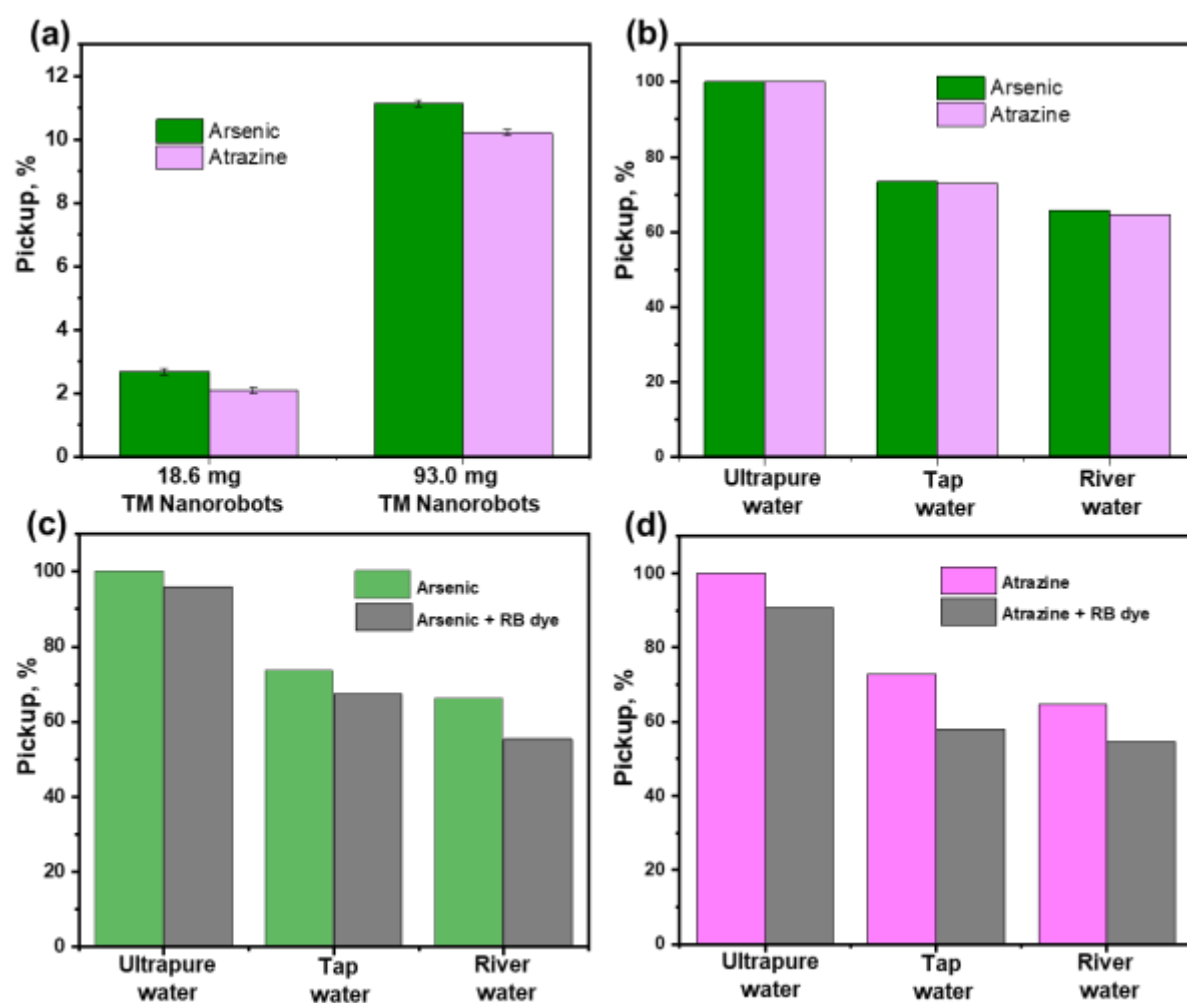
**Supplementary Figure 6:** Ionic strength study at varying sodium chloride solution (1mM to 100mM); (a) plot of velocity versus different frequency. Error bars in the velocity of TM nanorobots indicate the standard deviation obtained from three repeated experiments, (b) tracking optical images and (c) removal efficiency (note: different concentration of sodium chloride solution prepared in 5ppm arsenic).



**Supplementary Figure 7:** Langmuir isotherms for pollutants pickup at 25 °C (a-b) and disposal at 5 °C (c-d) by TM nanorobots. [Experimental conditions: TM nanorobots dosage = 0.0186 g L<sup>-1</sup>; magnetic field = 3 mT. 3Hz; contact time = 100 min].

**Supplementary Table 1:** Physico-chemical parameters for the pickup/disposal of pollutants by TM nanorobots, based on the data shown in Supplementary Figure 7 and Eq. 5.

| Fitting parameters | Arsenic  |         | Atrazine |         |
|--------------------|----------|---------|----------|---------|
|                    | at 25 °C | at 5 °C | at 25 °C | at 5 °C |
| $R^2$              | 0.89     | 0.88    | 0.88     | 0.91    |
| $q_m$ (mg/g)       | 3.4      | 2.3     | 3.3      | 2.0     |
| $K_L$ (L/mg)       | 0.022    | 0.012   | 0.019    | 0.013   |



**Supplementary Figure 8:** TM nanorobots efficiency in real polluted waters. (a) High concentration ( $100 \text{ mg L}^{-1}$ ) of pollutant pickup by TM nanorobots. The error bars represent standard deviation based on three measurements; (b) TM nanorobot pickup efficiency in ultrapure, tap and river water samples; (c) efficiency of TM nanorobots to pick up arsenic from realistic water samples with and without rhodamine B (RB) dye; (d) efficiency of TM nanorobots to pick up atrazine from realistic water samples with and without rhodamine B (RB) dye.