**Supporting information**

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**Fig.** S1 1H NMR spectrum of NAG monomer

**Calculations of the grafting density of carboxyl groups on PNAG-coated MNP after dispersing in water**

The amounts of carboxyl groups presenting on the MNP surface were quantitatively determined by a conductometric titration. The conductometric titration curve of the reaction between NaOH and HCl having a V-shape (Blank) shows (Fig. 1A). During the titration, the reaction that takes place in the titration vessel is following:



In the region I, before the end point, OH- is removed from the solution by reaction with H+, and Cl- is added to the solution. The conductance of the solution decreases prior to the end point. After the end point (region II), no OH- is available to react, and the conductance of the solution increases as a result of the additional of H+ and Cl-.

In the case of the titration of HCl with -COOH groups on the particle surface, the conductrometric titration curve exhibits three regions (Fig. 1B). Before the titration of -COOH groups on the particle surface, the -COOH coated on the particle surface was dispersed in an excess of NaOH solution. Thus, the reaction that takes place in the vessel is following:



In the region I of the titration, because basicity of excess OH- in the solution is stronger than that of -COO-, the OH- in the solution was first neutralized when HCl was titrated.



In the region II, when the OH- in the solution was completely neutralized, the H+ ions reacted with the -COO- groups on the MNP surface. After the COO- groups on the MNP surface were completely reacted with H+ ions, the solution conductivity sharply increase due to the excess of OH- and Na+ (region III). The measurement of the amounts of -COOH groups on the surface of the polymer-coated MNP was estimated from the following equation:

$$Carboxylic acid = \frac{M∆V}{m} $$

$$ = \frac{0.005 mol/L × (1.6 × 10^{-3 }L) }{2 × 10^{-3 }g} $$

$$ = 4.0 mmol/g $$



**Fig. S2** Examples of the conductometric titration curves, (A) the titration curve of HCl with NaOH and (B) the titration curve of HCl with carboxyl groups on the PNAG-coated MNP surface

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**Fig. S3**The calibration curve of theophylline standard with various concentration solution at pH 2.0



**Fig. S4** The calibration curve of theophylline standard with various concentration solution at pH 7.4



**Fig. S5** The calibration curve of theophylline standard with various concentration solution at pH 11.0



**Fig. S6** The calibration curve of theophylline standard with various concentration solution at 0.1 M HCl