**Supporting Information**

**to**

# $Fe_3O_4$ nanoparticles coated with a guanidinium-functionalized polyelectrolyte extend the pH range for phosphate binding

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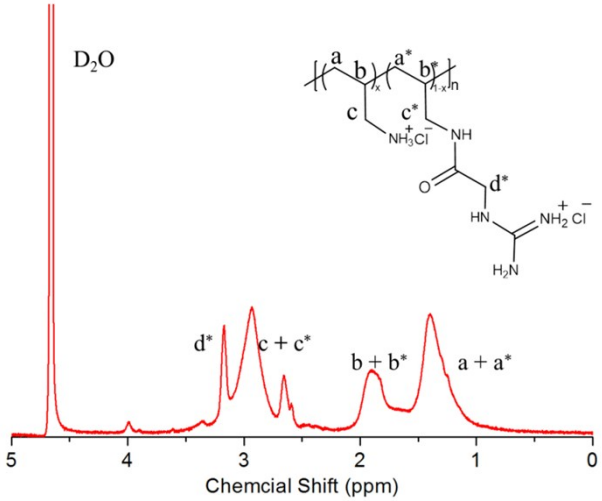


**Fig. S1** [1]H-NMR spectrum of polyallylamine hydrochloride functionalized with Gu moiety.

The synthesis was performed according to the work of Cao *et al.*[1] The substitution degree of PAH-Gu was 30% as estimated by the [1]H-NMR spectrum and the reaction yield was found to be 39% after dialysis.

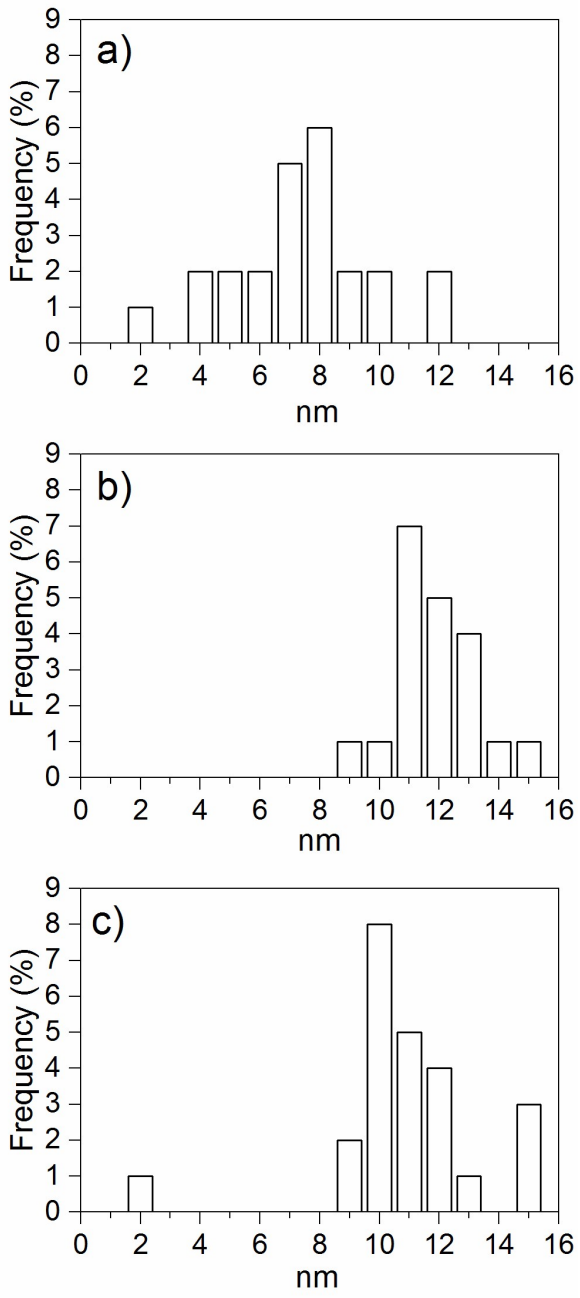


**Fig. S2** TEM-based size distribution plots of a) $Fe_3O_4$, b) $Fe_3O_4$@PAH, c) $Fe_3O_4$@PAHGu.

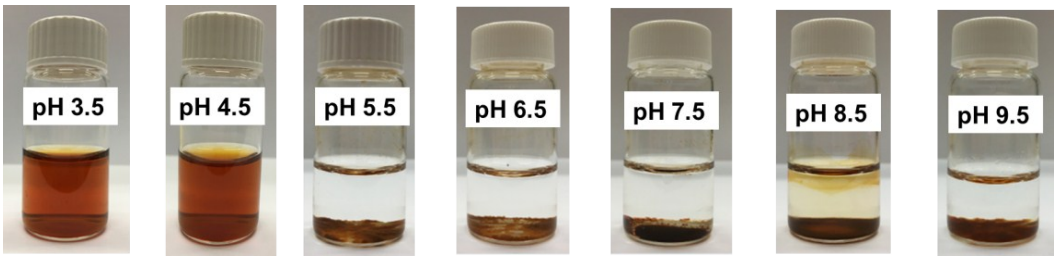


**Fig. S3** Pictures of vials containing an aqueous $Fe_3O_4$ suspension (0.5 g/L) taken 24 h after preparation at a pH range from 3.5 to 9.5.

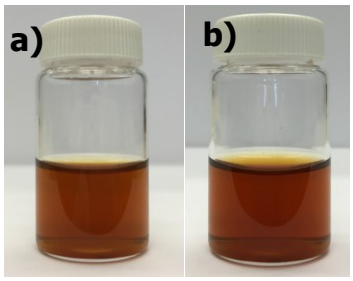


**Fig. S4** Pictures of a suspension of 0.5 g/L of $Fe_3O_4$@PAH-Gu at pH 9.5 taken after a) 24h and b) one week. Compared to $Fe_3O_4$ NPs at pH 9.5, $Fe_3O_4$@PAH-Gu maintains a stable colloidal suspension for months.

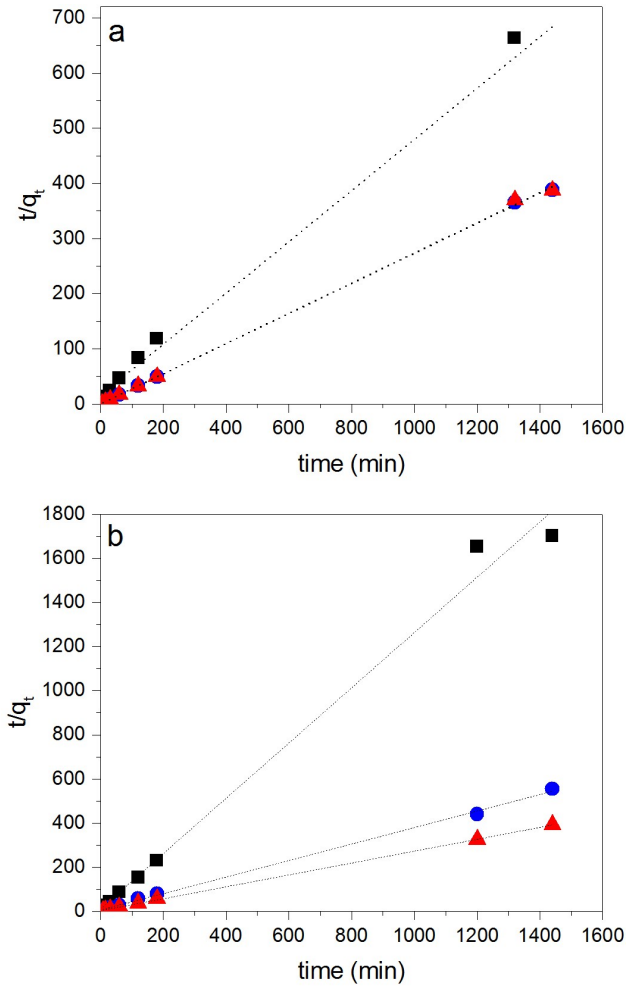


**Fig. S5**. Pseudo second-order linear fitting curves of different NPs: bare $Fe_3O_4$ (black), $Fe_3O_4$@PAH (blue) and $Fe_3O_4$@PAH-Gu (red) at a) pH 8 and b) pH 10.

**Table S1** Pseudo second-order non-linear curve fitting parameters, based on Eqn. 1.

| | pH 8 | | | pH 10 | | |
|---|---|---|---|---|---|---|
| | $q_e$ mg/g | $k_2$ mg/g/min | $R^2$ | $q_e$ mg/g | $k_2$ mg/g/min | $R^2$ |
| $Fe_3O_4$ | 2.00 | 0.0196 | 0.867 | 0.814 | 0.175 | 0.919 |
| $Fe_3O_4$@PAH | 3.65 | 1.03 | 0.999 | 2.45 | 0.083 | 0.949 |
| $Fe_3O_4$@PAH-Gu | 3.66 | 1.45 | 0.998 | 3.42 | 0.126 | 0.958 |

**Reference**

1. Z. Cao, P. I. Gordiichuk, K. Loos, E. J. R. Sudhölter and L. C. P. M. de Smet, *Soft Matter*, 2016, **12**, 1496–1505.