Electronic Supplementary Information

Switching off the interactions between graphene oxide and doxorubicin using vitamin C: combining simplicity and efficiency in drug delivery

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S1 TGA of GO-DOX nanocomposites

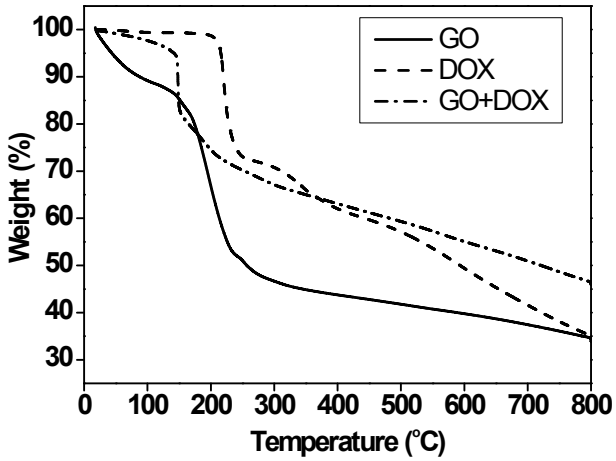

Fig. S1. TGA of GO, DOX and GO-DOX nanocomposites.

S2 DOX release from nGO-DOX

Compared with regular GO, nGO is more appropriate for drug delivery due to the ultrasmall size and better water dispersity. Using the same protocol as that used to create Fig. 3d, we investigated DOX release using nGO-DOX (Fig. S2). We obtained very similar results using nGO (rather than GO) as the carrier of DOX. The nGO exhibits similar chemical and physical attributes to regular GO except for lateral dimensions, and thus the previous studies of surface chemistry should be applicable[1]. Not surprisingly, we found the release of DOX using nGO was similar to that of regular GO (Fig. S2). The promotion of release by L-AA was much stronger in the first 6 h than in the later 42 hours. In the early hours, the concentration of L-AA was relatively high, resulting in fast reduction of nGO and thus plenty of DOX was released[2]. It was then slowed by L-AA consumption. In summary, both GO-DOX and nGO-DOX nanocomposites released DOX faster in acidic conditions than in neutral conditions, and more importantly, the introduction of L-AA facilitated the release of DOX from both GO and nGO.

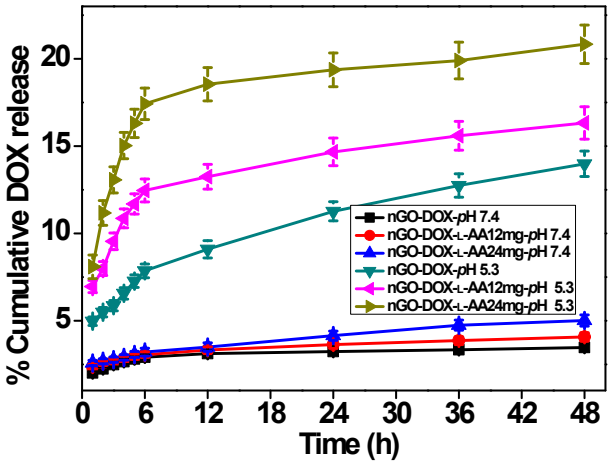

Fig. S2. *In vitro* release behaviour of DOX from nGO at *p*H 5.3 and 7.4 with and without L-AA.

S3 PEG grafted nGO

PEG was covalently functionalized onto nGO to further improve its water solubility. ATR-FTIR was used to confirm the covalent binding of PEG diamine on nGO sheets. The specific peaks of nGO sample (Fig. S3a, black curve) showed the presence of oxygen functional groups, with 1398 cm^{-1} for O-H bending vibration and 1720 cm^{-1} for C=O stretching vibration, respectively. The skeleton vibration was indicated with peak at 1600 cm^{-1}. Covalent binding of PEG introduced amido bond and amino groups which gave rise to the peaks from 1420 to 1635 cm^{-1} as shown in the red curve. Furthermore, peaks around 2900 cm^{-1} confirmed the presence of C-H which comes from PEG main chain. UV-Vis absorbance spectrum (Fig. S3b) of nGO-PEG shows both the shoulder around 230 nm and the strong absorbance below 200 nm, indicating the binding of PEG onto nGO surface. After self-assembling DOX onto nGO-PEG, the spectrum showed the peaks of DOX, one of which experienced a blue shift from 232 nm to 234 nm due to π-π stacking interactions.

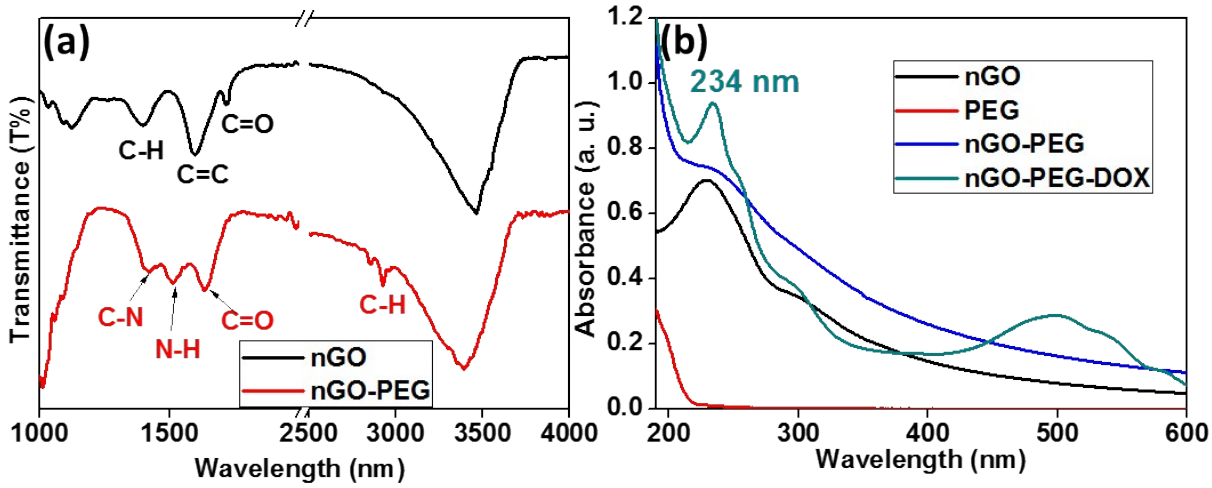

Fig. S3. (a) ATR-FTIR spectra of nGO and nGO-PEG; and (b) UV-Vis absorbance spectra of nGO, PEG, nGO-PEG and nGO-PEG-DOX.

References

1 J. Luo, L. J. Cote, V. C. Tung, A. T. L. Tan, P. E. Goins, J. Wu and J. Huang, *J. Am. Chem. Soc.*, 2010, **132**, 17667-17669.

2 J. Gao, F. Liu, Y. Liu, N. Ma, Z. Wang and X. Zhang, *Chem. Mater.*, 2010, **22**, 2213-2218.