Electronic Supplementary Information

Adsorption of Double-stranded DNA to Graphene Oxide Preventing Enzymatic Digestion

Haozhi Lei, Lijuan Mi, Xuejiao Zhou, Jiajia Chen, Jun Hu, Shouwu Guo, Yi Zhang

Email: zhangyi@sianp.ac.cn, swguo@sjtu.edu.cn

1. A 309 bps dsDNA binding to and protected by GO

To verify that dsDNA molecules with various lengths can bind to GO and be protected by GO from enzymatic digestion, a 309 bps dsDNA was tested. This dsDNA is a production of PCR amplification from a template of circular plasmid pBR322 with forward primer of CGC TAA CGG ATT CAC CAC and reverse primer of CAC GGA AAC CGA AGA CCA. Before using, the PCR product was purified by ethanol precipitation, and then re-dissolved in pure water.

It was found that the dsDNAs with varied lengths bound to GO and were well protected from digestion by DNase I. Figure S1 shows that the 309 bps dsDNA bound to GO in the buffer solution (lane 4) but not in pure water (lane 3), as supported by the broad distribution of the DNA band as well as the DNA dwelled in the sample well in lane 4. Subsequent experiment demonstrated that GO protected the 309 bps dsDNA from enzymatic digestion (please compare lane 5-7 with lane 2).

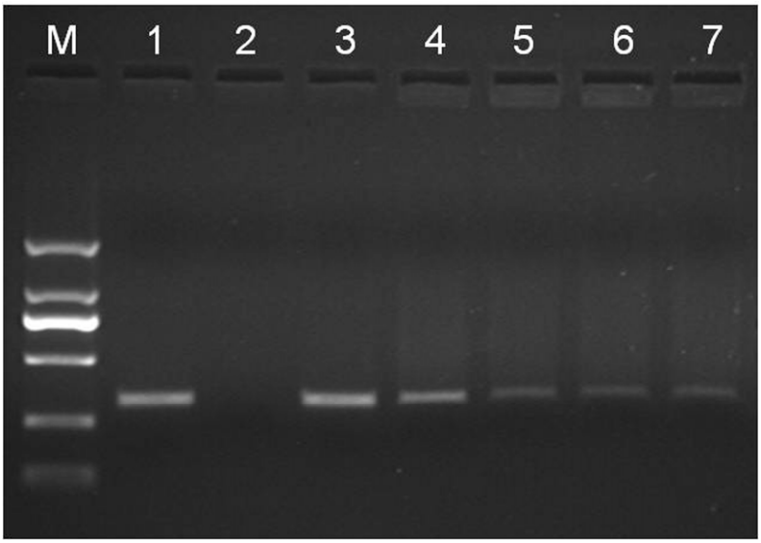

Figure S1. Image of agarose gel electrophoresis of a 309 bps dsDNA and its mixture with GO before and after DNase I treatment. Lane M: DNA marker; Lane 1: dsDNA only; lane 2: the dsDNA after digestion by DNase I for 1 min in reaction buffer; lane 3: mixture of dsDNA and GO (0.15 mg/ml) in pure water; lane 4: mixture of the dsDNA and GO (0.15 mg/ml) in reaction buffer; lane 5, 6, and 7: the dsDNA with GO after cleaved by DNase I in reaction buffer for 1 min, 30 min and 1 h, respectively.

2. Temperature effect on the adsorption and digestion process

The mixtures of GO (0.15 mg/ml) and 886 bps dsDNA in DNase I reaction buffer solution were incubated at 35°C, 55°C, and 70 °C, respectively, and was subjected to DNase I cleavage. It was found that more dsDNA would dwell at the sample wells and less dsDNA would present at its original bands after incubation of dsDNA with GO in buffer at higher temperatures (compare lane 2,3,4 in Figure S2), indicating more dsDNA bound to GO to form large complexes at higher temperatures. Enzymatic digestion experiment showed all the dsDNA samples that were mixed with GO and incubated at different temperatures were well protected by GO (see lane 9-11 in Figure S2).

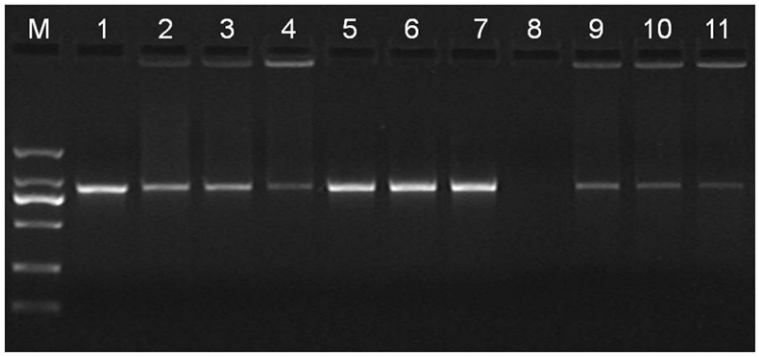

Figure S2. Image of agarose gel electrophoresis of the 886 bps dsDNA and its mixture with GO after incubation at different temperatures for 10 min. Lane M: DNA marker; Lane 1: dsDNA only; lane 2-4: the mixtures of dsDNA and GO in buffer after incubation at 35°C, 55°C, and 70 °C, respectively; lane 5-7: the mixtures of dsDNA and GO in pure water after incubation at 35°C, 55°C, and 70 °C, respectively; lane 8: the dsDNA after digestion by DNase I for 1 min; lane 9-11: the mixtures of dsDNA and GO in buffer after incubation at 35°C, 55°C, and 70 °C, respectively, followed by digestion by DNase I for 1 min.

3. Denatured dsDNA binding to and protected by GO

The 886 bps dsDNA was denatured at 95 °C for 4 min followed by quickly cooled with an ice bath. As shown in Figure S3, most of denatured DNA would dwell at the sample well (lane 8) after being mixed with GO in buffer, resulting in a faded band of denatured DNA; in contrast, most of un-denatured dsDNA presented in its original band (lane 3) after being mixed with GO in buffer. This result could be clear evidence showing that the denatured DNA binds more strongly to GO. In addition, it was found that both of dsDNA (compare lane 3 and 5) and denatured DNA (compare lane 8 and 10) are well protected by GO from cleavage of DNase I.

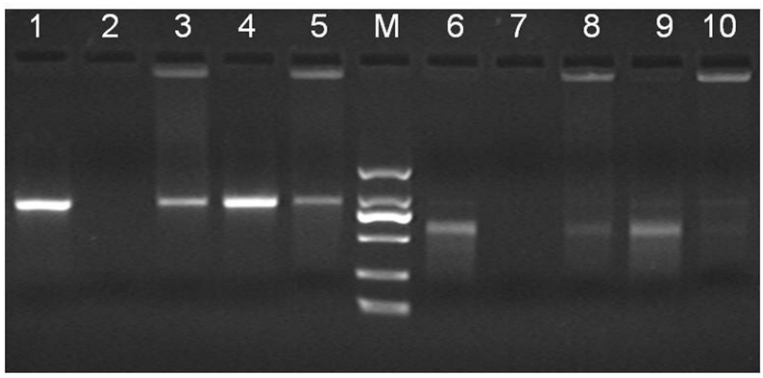

Figure S3. Image of agarose gel electrophoresis of the 886 bps dsDNA with or without

denaturation before being mixed with GO and subjected to DNase I digestion. Lane M: DNA marker; Lane 1 and 6: dsDNA and denatured DNA, respectively; lane 2 and 7: dsDNA and denatured DNA, respectively, after being digested by DNase I for 1 min; lane 3 and 8: mixture of dsDNA and GO (0.15 mg/ml) (lane 3) and mixture of denatured DNA and GO (0.15 mg/ml) (lane 8) in buffer; lane 4 and 9: mixture of dsDNA and GO (lane 4) and mixture of denatured DNA and GO (lane 9) in water; lane 5 and lane 10: mixture of dsDNA and GO (lane 5) and mixture of denatured DNA and GO (lane 10) in buffer after being digested by DNase I for 1 min.