Supporting information for:

Tune the bandgap of graphene quantum dots by gold nanoparticle-assisted O_2 plasma etching

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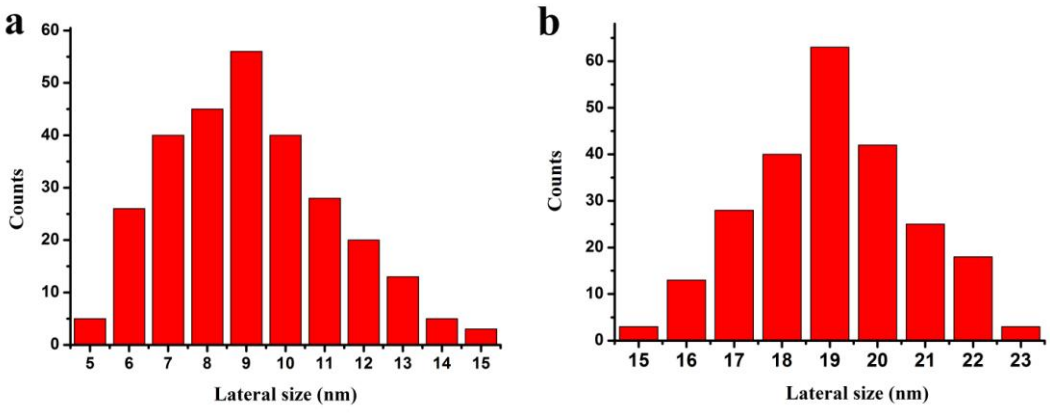

Fig. S1 Histograms of statistical lateral size distribution for GQDs etched from different gold NPs with diameter (a) 12 nm, and (b) 22 nm.

As shown in Fig. S1, the histograms of statistical lateral size show that GQDs size distribution in the 5–15 nm for GQDs ~9 nm, and size distribution in the 15–23 nm for GQDs ~19 nm.

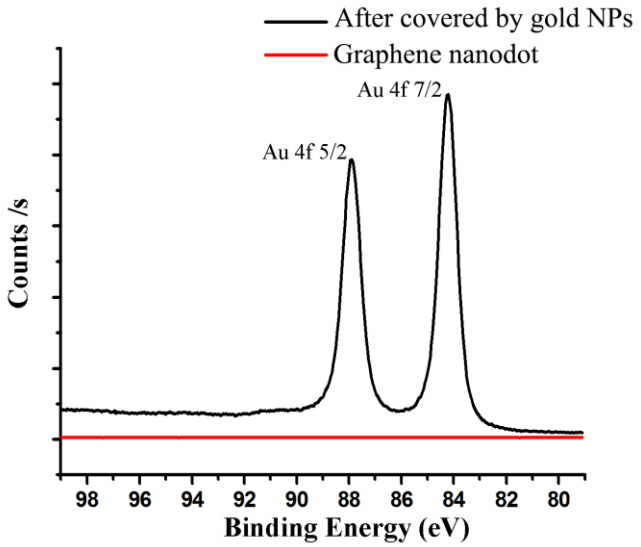

Fig. S2 XPS of samples before and after removing gold NPs.

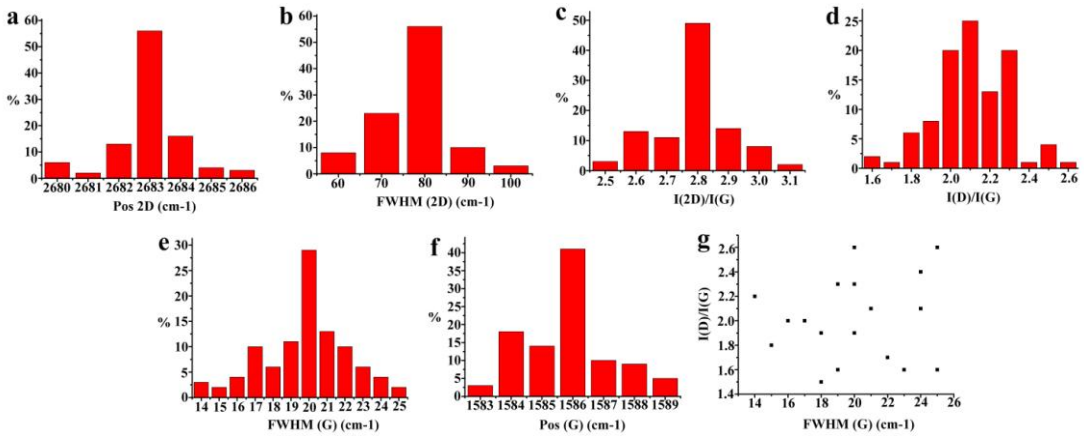

Fig. S3 Statistic of Raman analysis of pristine graphene and GQDs (~9 nm). Distribution of (a) Pos(2D), (b) FWHM (2D), (c) I(2D)/I(G), (d) I(D)/I(G), (e) FWHM(G), (f) Pos(G) and (g) I(D)/I(G) as a function of FWHM(G).

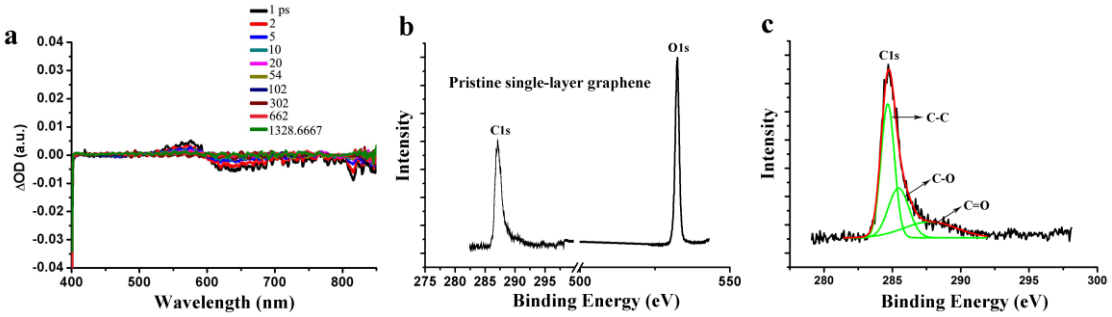

Fig. S4 (a) TA spectra of pristine single-layer graphene. (b) XPS measurement of pristine single-layer graphene. (c) Narrow scanned XPS analysis result in C1s of pristine single-layer graphene.

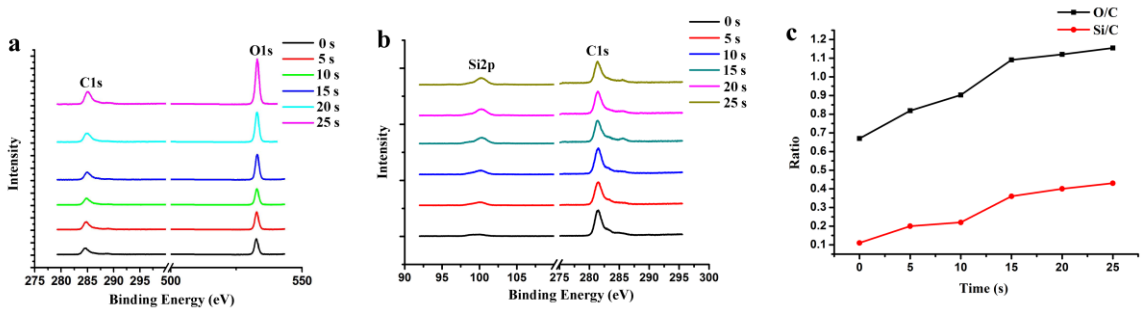

Fig. S5 XPS measurement of GQDs (~9 nm) etched at different time. (a) Spectra of C1s and O1s. (b) Spectra of Si2p and C1s. (c) The variation curve between O/C, Si/C ratio and etching duration.

The Si2p peak intensity is increasing gradually and C1s changed slightly as shown in Fig. S5b, which demonstrate the increase of exposed area of Si/SiO_2 substrate. And Si/C ratio is increasing during RIE as shown in Fig. S5c.

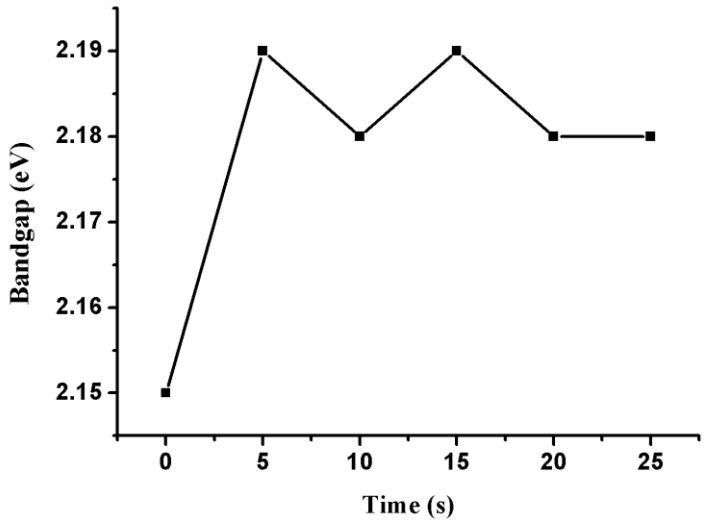

Fig. S6 The variation curve between bandgap and etching duration of GQDs (~19).

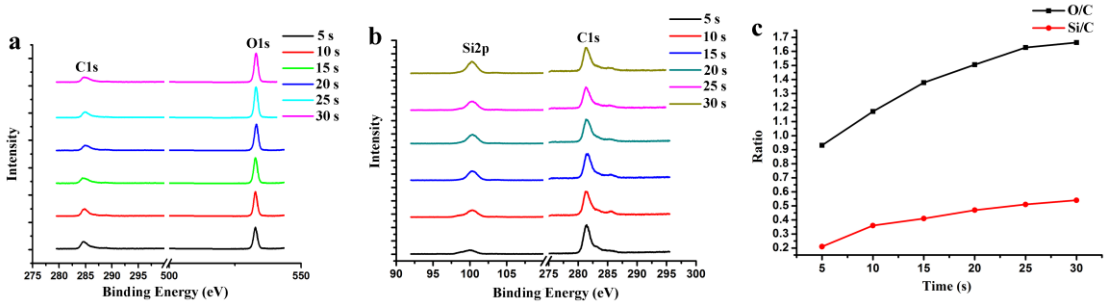

Fig. S7 XPS measurement of GQDs (~19 nm) etched at different time. (a) Spectra of C1s and O1s. (b) Spectra of Si2p and C1s. (c) The variation curve between O/C, Si/C ratio and etching duration.

As shown in Fig. S7a,c, oxygen ratio increase with etching duration increasing. But the level of oxygen ratio is much higher than the result in Fig. S5a and c, this is because that gold NPs (Fig. 6a) can't be arranged such closely as gold NPs shown in Fig. 2a, which lead to much more graphene is etched out. By contrasting the XPS result of Si2p shown in Fig. S7b, c and Fig. S5b,c, the higher signal intensity of Si2p (Fig. S7b) compared with the corresponding etching duration in Fig. S5b demonstrated bigger area of exposed Si/SiO_2 substrate.