Supporting Information

Microwave-Assisted Synthesis of Highly Water-Soluble Graphene Towards Electrical DNA Sensor

Bong Gill Choi, HoSeok Park, Min Ho Yang, Young Mee Jung, San Yup Lee, Won Hi Hong and Tae Jung Park**

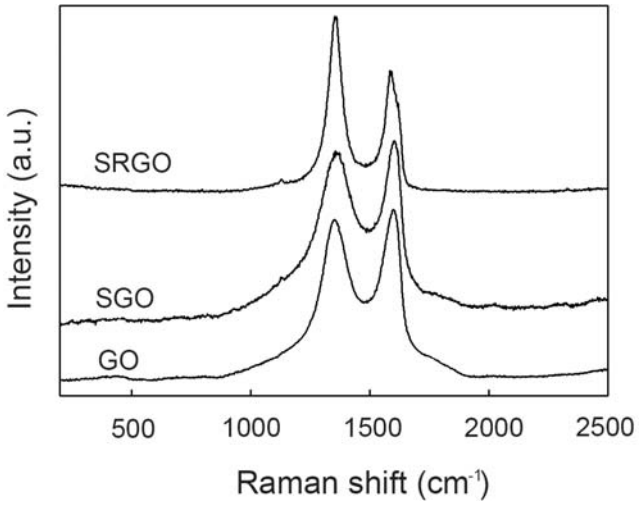

Fig. S1 Raman spectra of GO, SGO, and SRGO.

The Raman spectrum of graphene oxide (GO) showed two prominent bands at 1600 cm^{-1} and 1350 cm^{-1}, which correspond to the G and D bands. The dominant peak of D bands is indicative of the existence of defects such as hydroxyl and epoxide groups in the in-plane sp^2 conjugated structure of functionalized GO due to extensive oxidation.[1] When GOs reduced with chemical treatment into reduced graphene oxide (RGO), the ratio of D/G intensity increased, compared to that in GO by means of the decrease in the average size of the sp^2 domains of the GOs during the reduction.[2] After the microwave radiation treatment of GOs, the SGO depicts the both G and D bands at 1601 cm^{-1} and 1358 cm^{-1} with a similar D/G intensity ratio of GO. In comparison of GO and SGO, the SRGO shows the higher intensity ratio of D/G than that of GO, indicating the successful reduction of SRGO.

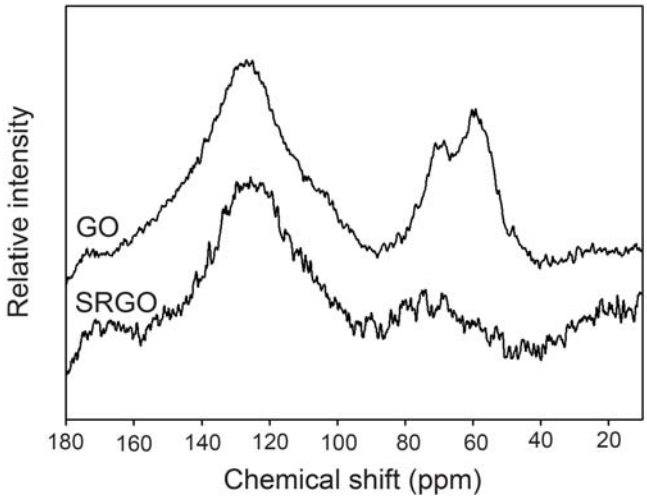

Fig. S2 Solid-state ^{13}C MAS NMR spectra of GO and SRGO.

The NMR spectra of GO and SRGO demonstrated the reduced state of SRGO by significant structural change after microwave treatment and chemical reduction of GOs. GOs exhibit three distinct resonances: the bands of un-oxidized sp^2 carbons at 127 ppm, the hydroxyl groups at 69 ppm, and the epoxide groups at 59 ppm.[2] After final reduction step to SRGOs, two major peaks of oxygenated and carbonyl carbons were significantly reduced, while the prominent peak of 125 ppm was remained; the resonance at 125 ppm was broadened and shifted by chemical shift distribution and chemically environmental changes of carbon atoms.

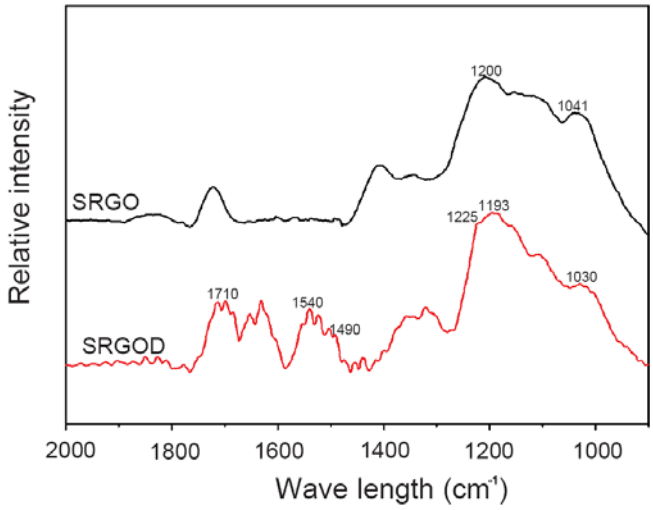

Fig. S3 FT-IR spectra of SRGO and SRGOD.

The SRGO and probe DNA complexes showed the evident characteristic bands of probe DNAs, compared to the SRGO. The band at 1710 cm^{-1} in SRGOD represents the DNA base units.[3] The two bands at 1540 and 1490 cm^{-1} were attributed to the ring stretch of benzenoid on the DNA bases.[3] In particular, the stretching band of 1041cm^{-1} for $–SO_3$ groups in SRGO was shifted to 1030 cm^{-1} for SRGOD, and the band width was broadened due to the ionic interactions between the sulfonic groups of SRGO and the amine groups of probe DNAs.

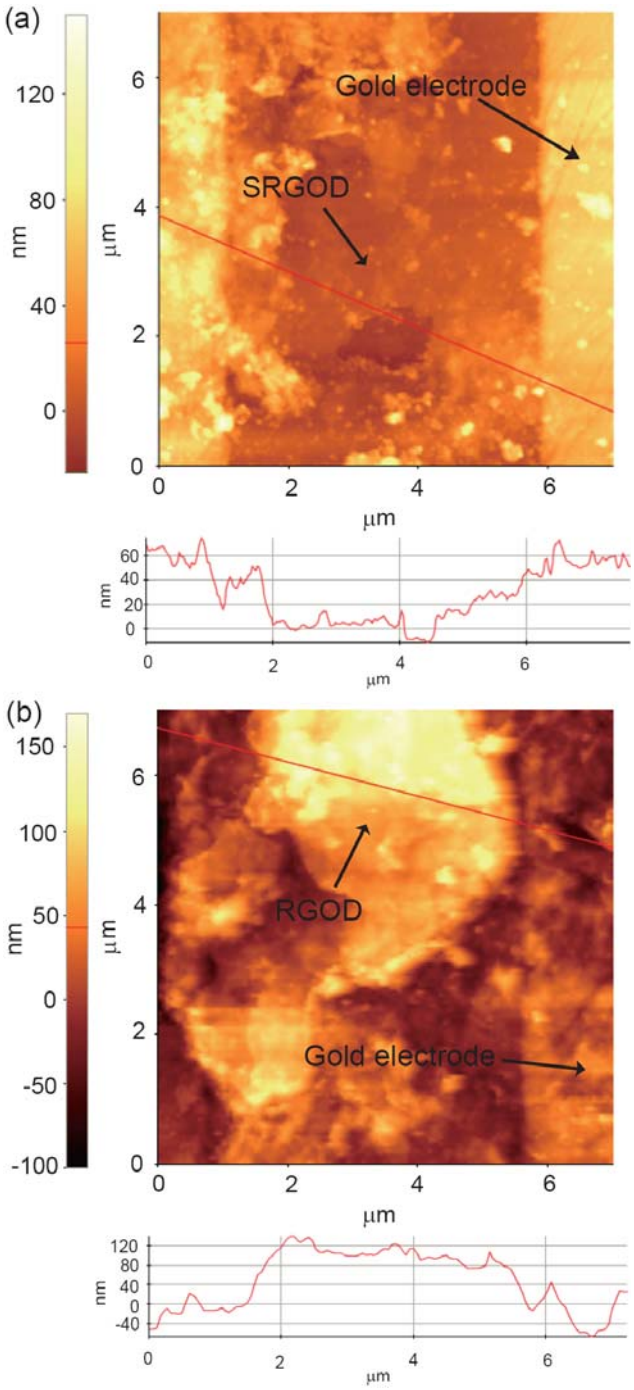

Fig. S4 AFM image of (a) SRGODs and (b) RGODs across two gold electrodes.

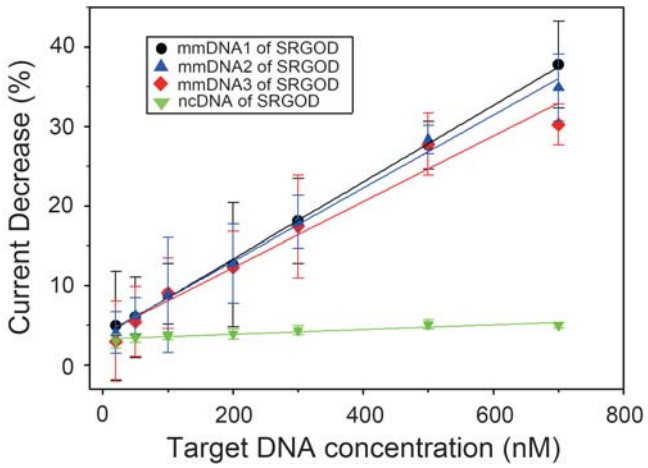

Fig. S5 Comparison of electrical sensing characteristics of SRGOD sensors for the hybridization with mmDNA1, mmDNA2, mmDNA3, and ncDNA, respectively.

References

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