Supplementary Information

Characterization and Drug Release Behavior of Highly Responsive and Chip-like Electrically Modulated Reduced Graphene Oxide/ Poly(vinyl alcohol) Membranes

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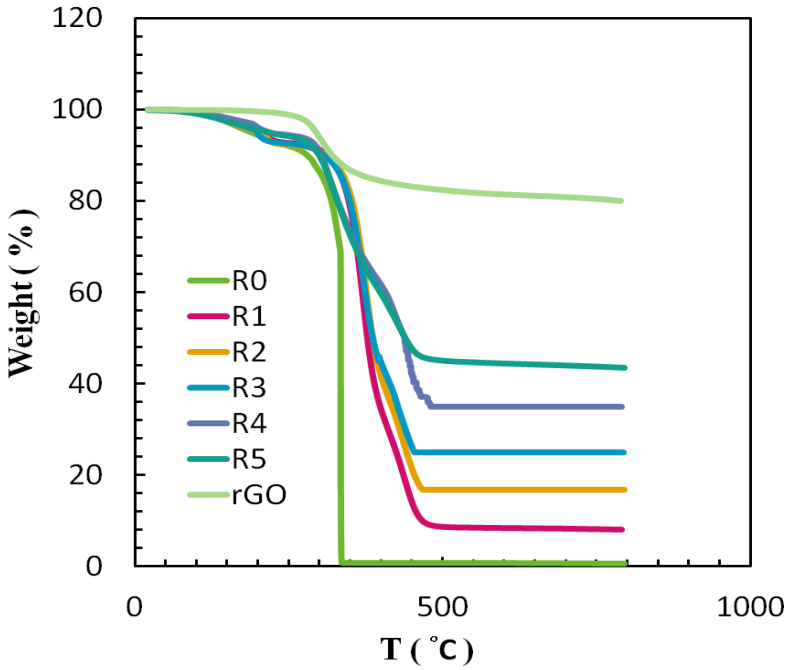

Fig. S1 Thermogravimetric curves of pure PVA, reduced greaphene oxide, and rGO/PVA hydrogels with different rGO loading.

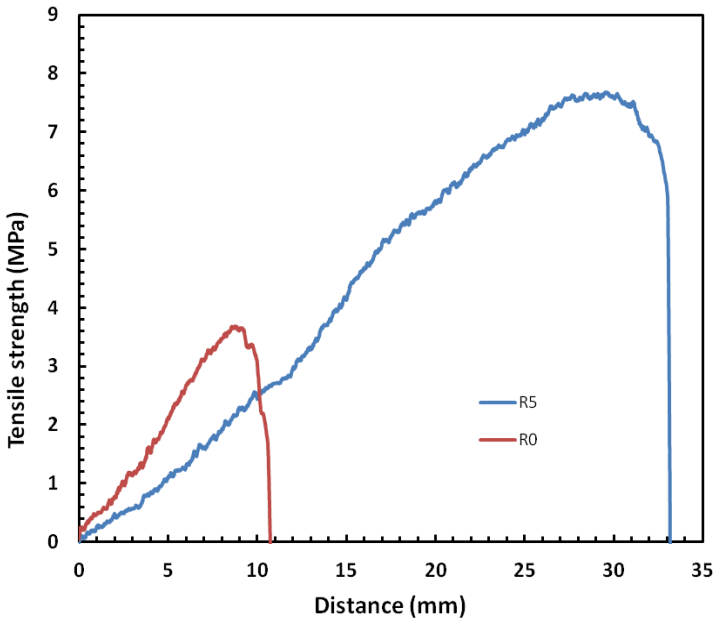

Fig. S2 The hybrid hydrogels higher rGO content show much enhanced mechanical property.

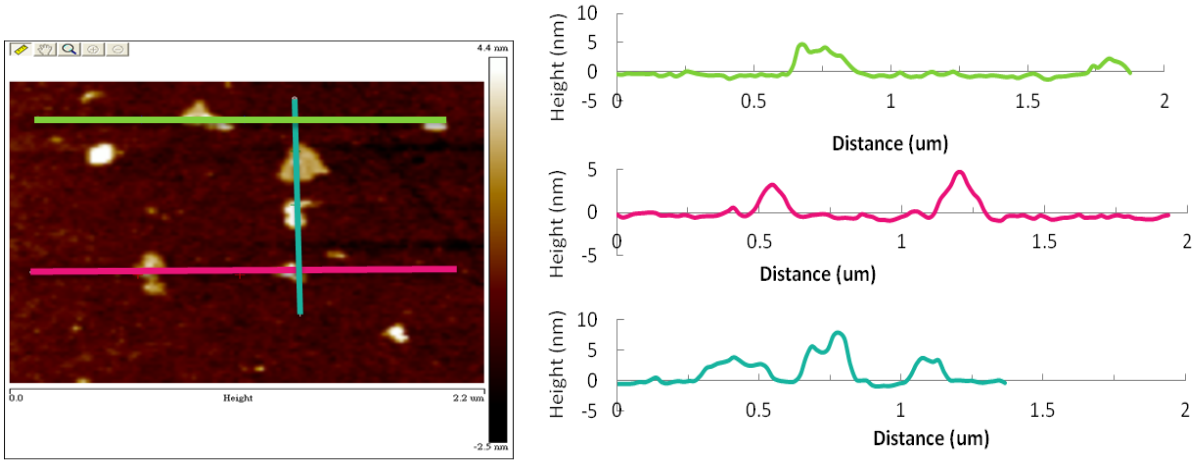

Fig. S3 AFM image of exfoliated rGO sheets with three height profiles acquired in different locations.

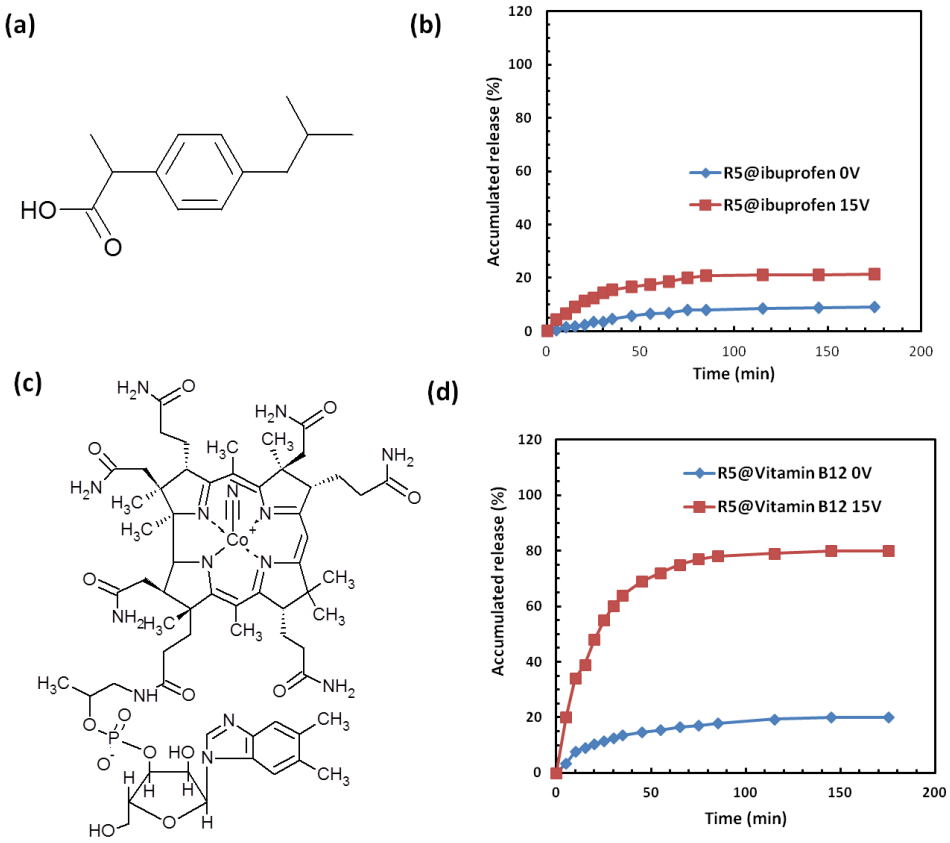

Fig. S4 (a) The chemical structure of ibuprofen (hydrophobic drug). (b) The drug release behavior of ibuprofen from R5 rGO/PVA hydrogel. (c) The chemical structure of vitamin B_{12} (higher molecular weight and hydrophilic drug). (d) The drug release behavior of vitamin B_{12} from R5 rGO/PVA hydrogel. All the drug release results reflect the average of three measurements, and the difference between each measurement is < 5%.

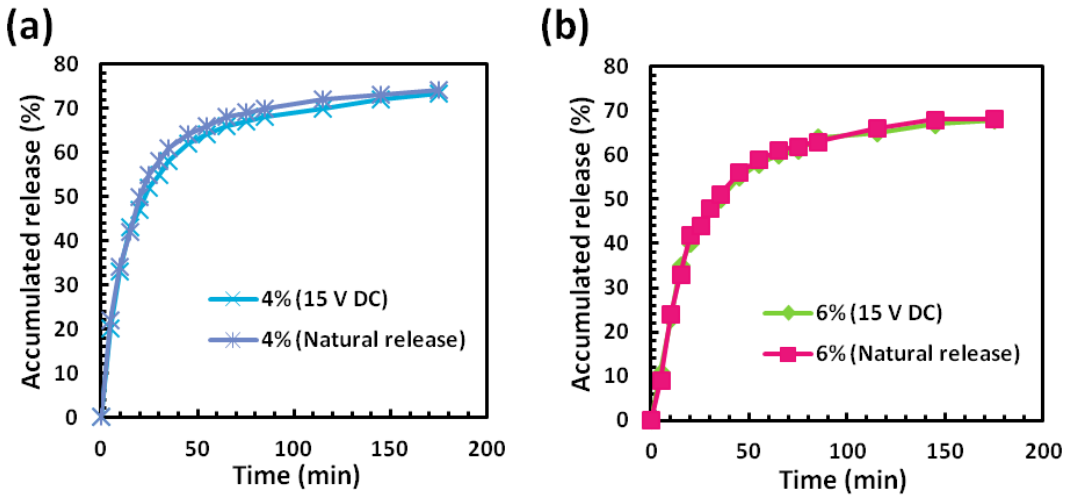

Fig. S5 The accumulated natural and electrically-stimulated release of rGO/PVA hydrogel with (a) 4 wt% rGO (b) 6 wt% rGO. Both natural and electrical-stimulation release displayed almost the same drug released amount for the rGO/PVA hydrogels with the rGO loading below 8.11wt%. The electrical stimulation did not show an enhancement in the drug released amount for 4wt% and 6wt% rGO-loaded hydrogels. Moreover, the cumulative released drug level of the electrically-stimulated hydrogels is slight reduction as compared to those naturally released. For 4wt% rGO, the accumulated release level for natural release is 74.12%, while for electrical stimulation is 73.33%. For 6wt% rGO, the accumulated release level for natural release is 68.13%, while for electrical stimulation is 67.89%.

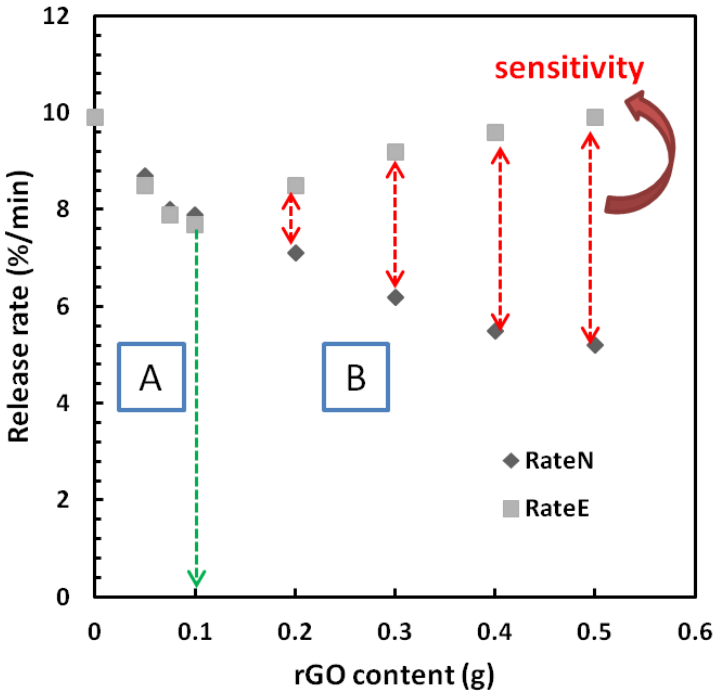

Fig. S6 Electric sensitivity of rGO/PVA hydrogel for naturally-released rate (R_N) and the electrically-stimulated released rate (R_E) under applied with a constant applied voltage(15 V) at a short time period in terms of the content of rGO. (Region A: little sensitivity; Region B: region of increasing sensitivity)

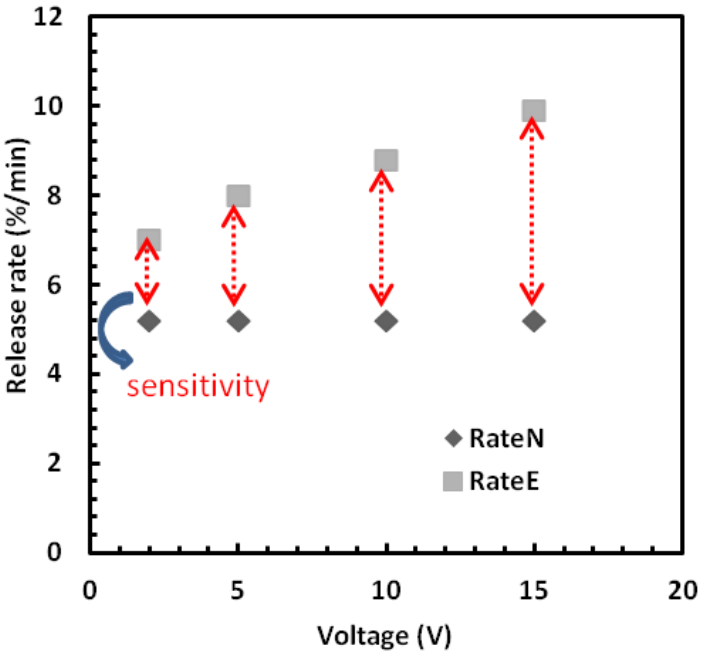

Fig. S7 Electric sensitivity of R5 rGO/PVA hydrogel for the naturally-released rate (R_N) and electrically-stimulated released rate (R_E) under different voltage stimulation at a short time period .