Graphene/waste-newspaper cellulose composite aerogels with selective adsorption of organic dyes: Preparation, characterization and adsorption mechanism

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As shown in Fig. S1, GO exhibits two strong peaks at 1649 and 3413 cm^{-1}, assigning to C=C skeletal vibration from graphitic domains and -OH stretching vibration, respectively. Moreover, small shoulder peaks at about 1740 cm^{-1} (C=O stretching vibration from carbonyl and carboxylic groups) and 1105 cm^{-1} (C-O stretching vibration) indicate that many oxygen-containing functional groups existed on the surface of GO. GNS displays two obvious absorption peaks at around 3421 and 1630 cm^{-1}, corresponding to –OH of the adsorbed water and C=C stretching vibration of benzene ring, respectively.

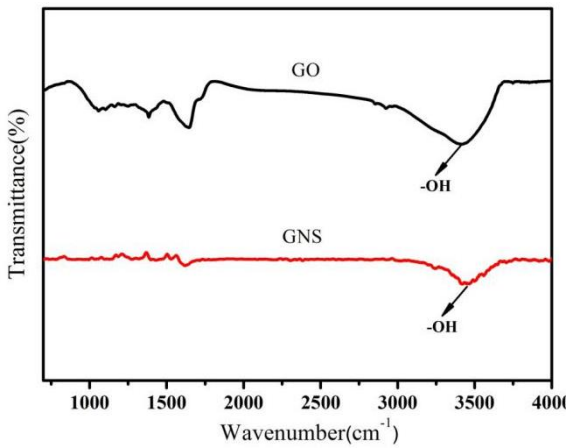

Fig. S1 FT-IR spectra of GO and GNS.

A thin and broad layer of GNS observed from the SEM image in Fig. S2, which reveals that GNS is fully exfoliated in water and exhibits a large surface area. Furthermore, the surface of sheet structure provides a large number of adsorption sites that can effectively capture dye molecules in solution.

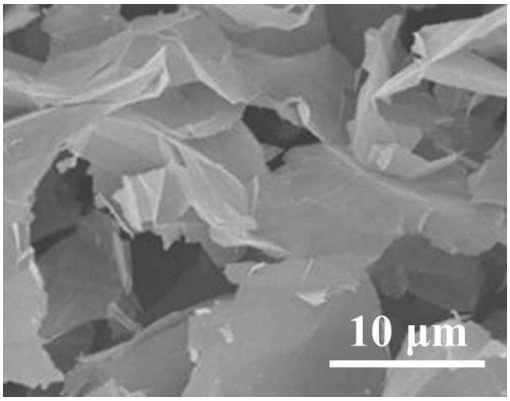

Fig S2. SEM image of GNS.

The pore characteristics of cellulose aerogel and GO/cellulose aerogel were investigated in Tab. S1. The specific surface area of GO/cellulose aerogel increased obviously with the presence of GO fillers while the pore size is inconsistent with the results observed in the SEM (Fig. 3e-f), which attributed to non-uniform pore structure of composite aerogel.

Table S1

Characteristic parameters for cellulose aerogel and cellulose/GO aerogel.

Sample	Pore size (nm)	Pore volume (cm^3/g)	$S_{BET}(m^2/g)$
Cellulose aerogel	3.041	0.061	0.596
Cellulose/GO aerogel	22.143	0.061	136.261

The adsorption capacity by the present composite aerogel is compared with other adsorbents in Tab. S2. It was observed that our present material possessed the capacity of much higher adsorption than some reported work. It not only improves the removal of MB dye, but the utilization of low filler content of 0.5wt% realizes quickly high elimination efficiency only 30 min. The partition coefficient (PC) was used as a basic guideline to evaluate capacity more objectively between different materials (or conditions) as a performance metric [1]. The PC can be determined from the adsorption capacity and dye concentration, it can be obtained from the following equation (1):

$$PC = \frac{q_e}{c_0 * E} \tag{1}$$

Where q_e is the adsorption capacity of aerogel (mg/L), c_0 is the initial dye concentration (μmol/L) of solution, and E is dye removal efficiencythe (%). The highest PC value was obtained from the present work, which suggest WGO0.5 and WGN0.5 are favourable for the asorption of MB and CR. This may be attributed to the formation of strong interaction force between the composite aerogels and dyes.

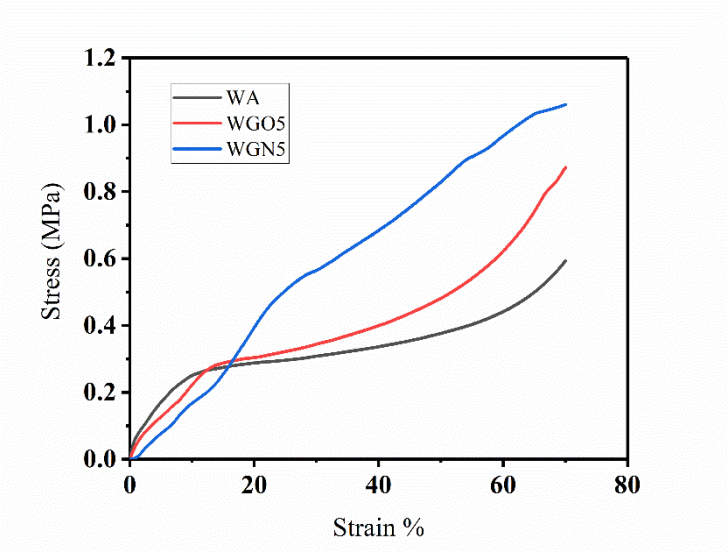

Fig S3. Mechanical strength of WCE, WGNS5 and WGO5.

References

[1] Q.H. Bai, Q.C. Xiong, C. Li, Y.H. Shen, H. Uyama. Hierarchical porous cellulose/activated carbon composite monolith for efficient adsorption of dyes. Cellulose 24 (2017) 1-15.