## **Supplementary figures:**

**Hall Effect measurements:** To investigate the room-temperature Hall mobility and carrier concentration for the a-C and rGO films, the HMS-3000 Hall measurement system (Ecopia, Anyang, South Korea) was employed. The measurements were calibrated with standard ITO films. This measurement procedure enabled us to investigate the structure, topology, and electron conduction characteristics of the liquid phase grown rGO films at various annealing energy densities.

**IV measurements**: The IV measurements were carried out using custom-built LabVIEW software (National Instruments, Austin, TX, USA). Two probes were used as contacts. Flexing crocodile clips were utilized for measurements.



**Figure S1:** (a) Optical micrograph of laser patterned non-doped DLC (0.3 Jcm<sup>-2</sup>), (b) HRSEM micrograph of rGO film.



**Figure S2**-(a) resistivity measurements for 21 at% Si subjected to different laser annealing energy densities, (b) IV measurement for laser annealed DLC, and (c) SEM micrograph of Si-DLC after 100 rounds of cyclic bending.



**Figure S3:** The C (1s) XPS spectrum of Si-DLC (a) before laser annealing, and (b) after laser annealing (0.6 Jcm<sup>-2</sup>).