Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Enhancing Graphene-metal Contact using Graphene Square Flake Array Sandwich Structure

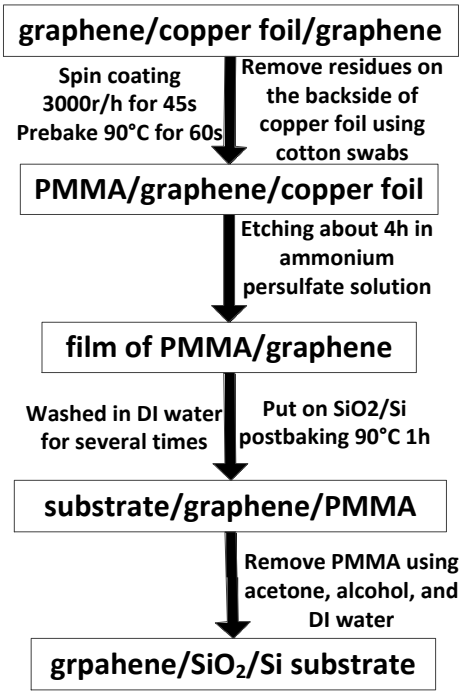

Fig. S1. Process of graphene transfer from copper foil to SiO_2/Si substrate

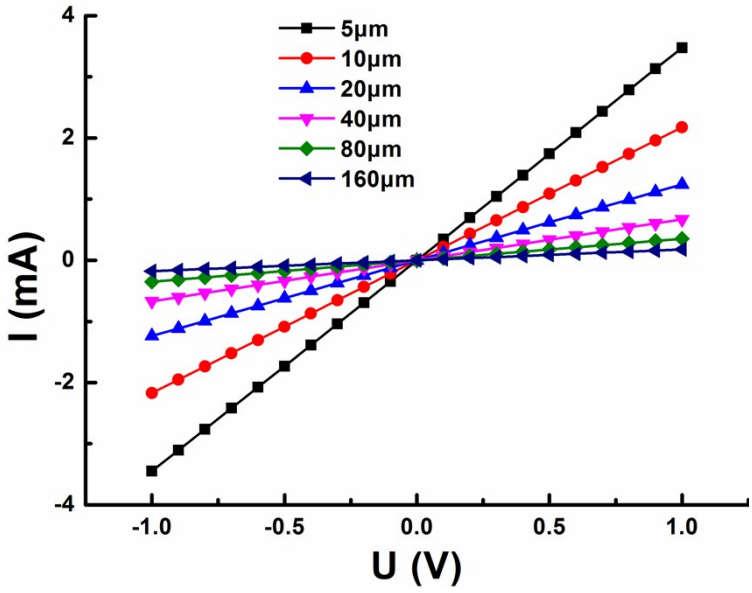

Fig.S2. I-V characterization of different lengths of graphene channels with GSF.

In Fig. S3, L was the length of grapheme channel, W was the width of graphene channel, R_s was sheet resistance, R was resistance for the graphene length of L, R_c was contact resistance, d_T was the length of charge transfer region.

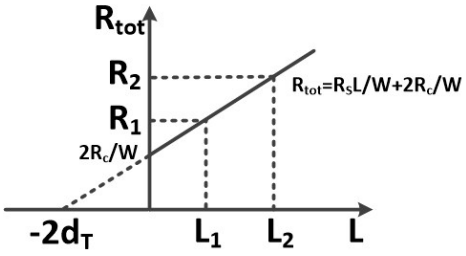

Fig. S3. Illustration of TLM method for calculating contact resistance R_c.

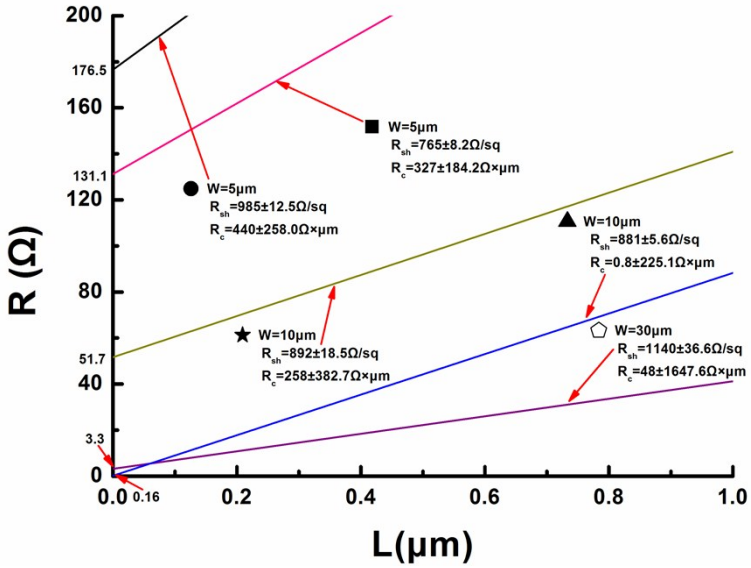

Fig. S4. Zoom- in figure (0 to 1um) of extracted R_c values with GSF for different widths of graphene channels.

Before design of GSF contact structure, we have fabricated similar GSF contact structure in which the graphene channel we used is milimeter-size single-crystal CVD graphene island, and GSF is stack on single-crystal graphene of electrode area. On 100nm SiO2/Si substrate we fabricated two kinds of different three terminal devices of (a) without GSF, and (b) with GSF.

The back-gate Id-Vbg transfer curves on 100nm SiO2/Si of two kinds devices (W=5um, L=10um) are shown in Fig. S4 which was tested in air and room temperature. We use the equation (S1) to calculate carrier mobility μ and the calculated carrier mobility of two structures are listed in table S1, where $\frac{\Delta I_d}{\Delta V_{gs}}$ is the ratio of drain current and gate voltage, $\frac{L}{W}$ is the ratio of channel length and width, C_{ox} is gate capacitance and V_{ds} is the source-drain voltage. All the parameters can be extracted in the transfer characteristic.

$$\mu = \frac{\Delta I_d}{\Delta V_{gs}} \cdot \frac{L}{W} \cdot \frac{1}{C_{ox} V_{ds}} \qquad \text{(S1)}$$

The decrease of contact resistance for with GSF contact graphene device would surely improve the performance of graphene device. The effect of GSF to the quality of graphene is only on the position of contacted area not the position of channel region. But the carrier mobility should be improved for GSF structure because of the smaller Rc and larger Id.

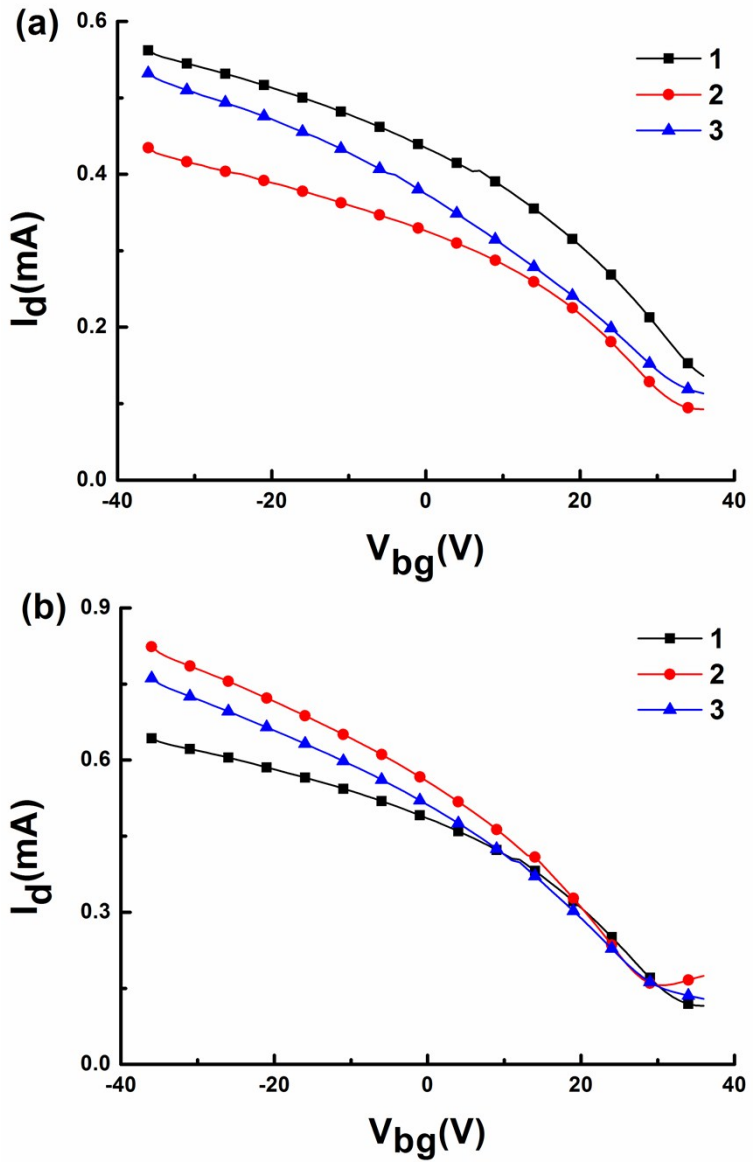

Fig. S5. Back-gate I_d-V_{bg} transfer curve of devices without (a) and with (b) GSF.

Table S1. Carrier mobility of two structures

Structure types	a-without GSF	b-with GSF
Carrier mobility(cm^2/Vs)	490.4	615.2