Mass Transport on Graphene

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Primary CNF Tools Used: Photolithography tools, ABM contact aligner, Zeiss Ultra SEM

Summary of Research:

The development of nanotechnology requires versatile manipulation tools for atomic scale assembly and controlled material delivery. Scanning tunneling microscope (STM), atomic force microscope (AFM) have been demonstrated as powerful tools for manipulation atoms and molecules on clean surfaces. However, these tools suffer from low delivery efficiency: they are not capable to deliver nanometer scale features containing large amounts of atoms, and they cannot deliver atom efficiently to desired work area (sticky).

Carbon nanotubes and graphene have been suggested as possible nanoscale mass conveyors with electric field as source of applied force. Controllable and reversible atomic metal transportation along carbon nanotubes (CNTs) and transport of more than 10^7 atoms have been demonstrated [1-3]. Graphene is mechanically robust and chemically inert; it can sustain large current density similar to CNTs. It has advantage over CNTs that more complicated mass transport circuits can be designed with lithography techniques[4-7].

Despite experiments that show the Al plate transport along graphene in crossroad configuration, the more complicated transport circuit and the other type of transport species, and atomic scale transport are needed to be tested. Theoretical model on the nature of the driving mechanism will also be developed.

References:

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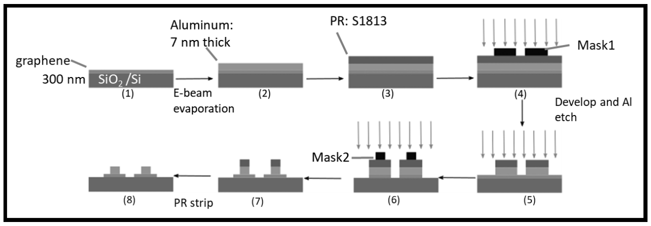

Figure 1: Process flow for making Al pads on graphene by Al etching.

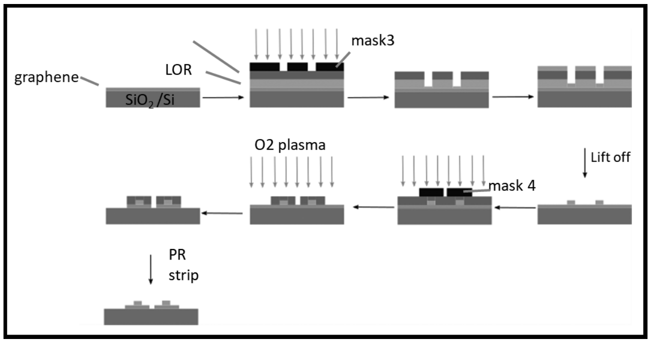

Figure 2: Process flow for making Al pads on graphene ribbon by lift off.

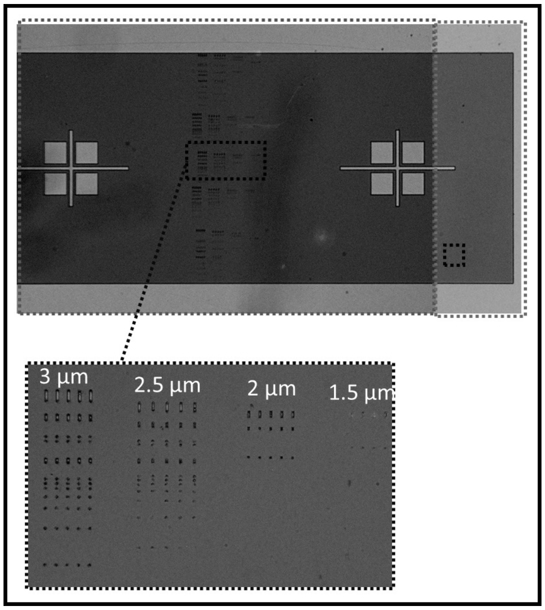

Figure 3: Al pads on graphene before stripping photoresist.

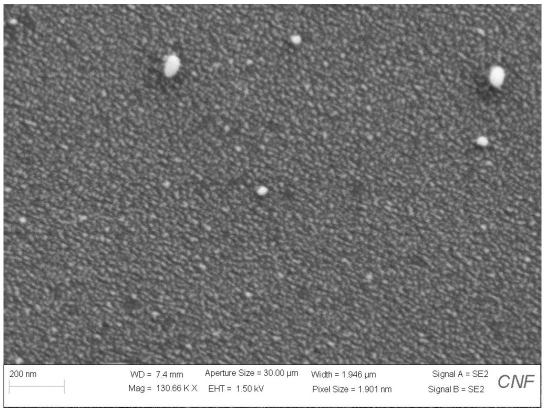

Figure 4: Topography of Al thin film after annealing.