Structured Graphene Devices for Mass Transport

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We report on the achievement of reversible atomic mass transport along graphene devices [1]. The motion of Al and Au in the form of atoms or clusters is driven by applying an electric field (between the metal electrodes that contact the graphene sheet). We show that Al moves in the direction of the applied electric field whereas Au tends to diffuse in all directions. The control of the motion of Al is further demonstrated by achieving a 90 degrees turn, using a graphene device patterned in a crossroad configuration. The controlled motion of Al is attributed to the charge transfer from Al onto the graphene so Al is effectively charged and can be accelerated by the applied electric field. In order to get further insight into the actuation mechanism, we carry out theoretical simulations of individual Al and Au impurities on a perfect graphene sheet. The direct (electrostatic) force is found to be ~1 pN and to be dominant over the wind force. Our findings hold promise for practical use in future mass transport in complex circuits.

References

[1] A. Barreiro, R. Rurali, E. R. Hernandez, A. Bachtold, Small **accepted** (2011)

Figures

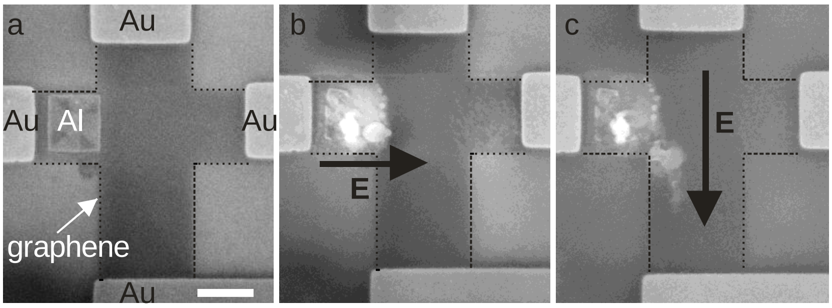

Figure 1 (a) Scanning electron microscopy image of a graphene device structured in a crossroad configuration with one Al plate. The scale bar is 1 µm. (b,c) Motion of the aluminum after having applied an electric field in different directions (indicated by the arrow). In (b) we applied a voltage *V* of 9 V during *t*= 6 minutes and the current *I* was 1.4 mA; in (c) *V* = 12.7 V, *I* = 1.63 mA, *t* = 9 minutes.