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Simple and Low Cost Fabrication of Hydrogen Silsesquioxane Encapsulated Graphene Devices

Abstract

We have developed a novel yet simple process to fabricate chemical vapour deposition graphene devices that are encapsulated by hydrogen silsesquioxane (HSQ), enabled by the implementation of edge contacts [1, 2, 3]. The upper graphene surface is protected by HSQ from the very first processing step (c.f., Figure 1), leading to significant carrier mobility enhancements in completed devices. Upon remeasuring after two weeks, the electrical properties of all structures remained unchanged and the estimated mobilities were the same within a few percent (c.f., Figure 2). Without full optimization, Ohmic contacts are achieved with a specific contact resistance of approximately 500 Ω·µm. The fact that HSQ can be left in place avoids the use of strong caustic acids such as hydrofluoric acid solution [4], making the fabrication process simpler and safer. Moreover, instead of using electron-beam lithography for contact patterning, we use a direct laser writer to lower the processing cost while retaining high quality devices. Our technique can be readily extended to other 2D materials, e.g., environmentally-sensitive ones such as black phosphorus, FeSe and Silicene. It could also find important applications in the HSQ–assisted transfer [5] of graphene and other 2D materials, significantly improving the material quality and performance of resulting devices.

References

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Figures

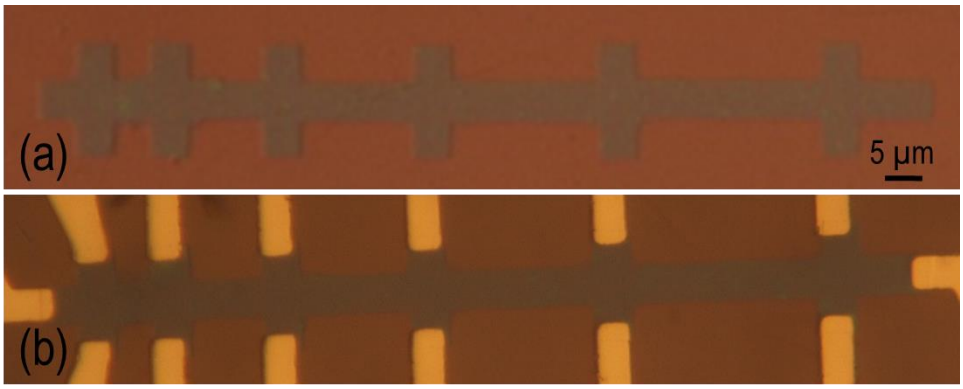

Figure 1: Optical images of a typical device with 2% HSQ. (a) After HSQ crosslinking and development. (b) Completed device. The total device length is 125 µm and the width is 5 µm.

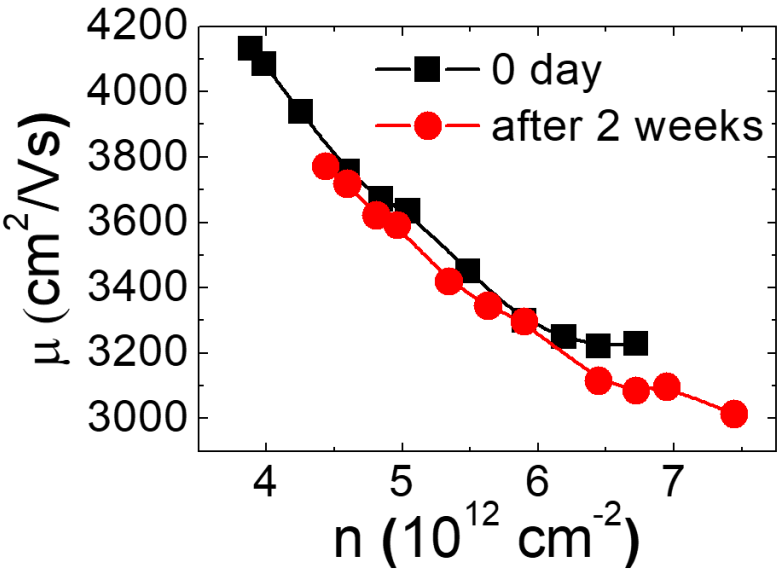

Figure 2: Electrical stability of device in air after HSQ encapsulation.