Working towards quality preservation of epitaxial graphene devices by amorphous boron nitride encapsulation

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Homogeneous monolayer epitaxial graphene (EG) is an ideal candidate for the development of a quantum Hall resistance (QHR) standard.[1-3] A clean fabrication process was used to produce EG-based quantum Hall devices with n-type doping level of order 10^{12} cm^{-2}. Generally, electrical properties of EG, such as longitudinal resistivity and carrier density, remain unstable when devices are exposed to air due to adsorption of molecular dopants, whose presence shifts the carrier density close to the Dirac point (<10^{10} cm^{-2}) or into the p-type regime. Here we report experimental results on the use of amorphous boron nitride (aBN) as an encapsulation layer, whereby EG can maintain some of its electrical properties under ambient laboratory conditions for at least a few days. Furthermore, we exposed one dozen devices to controllable temperatures up to 85°C and relative humidities up to 85% and report that a 15 - 20 nm aBN encapsulation thickness is sufficient to preserve longitudinal resistivity to within 10% of its previously-measured value (see Figure 1). We monitored the electronic properties of our encapsulated and unprotected EG samples by room temperature magnetotransport measurements using a neodymium iron boron (NIB) magnet. Our results have essential importance in the mass production of millimeter-scale graphene devices[4] with stable electrical properties.

References

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Figures

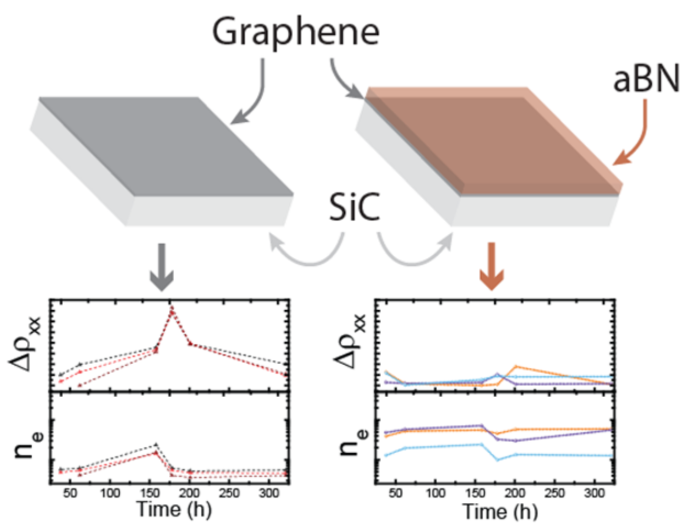

Figure 1: Illustration of the benefits of aBN encapsulation on attempts to preserve electrical properties such as carrier density and longitudinal resistivity.