Floating transfer optimization of large-area chemical vapor deposition graphene on AlN as advanced electrodes for bulk acoustic wave devices

Marius Knapp, Katarzyna Holc, Vadim Lebedev, Oliver Ambacher, René Hoffmann

Fraunhofer Institute for Applied Solid State Physics, Tullastraße 72, 79108 Germany, Freiburg
mariusknapp@iaf-extern.fraunhofer.de

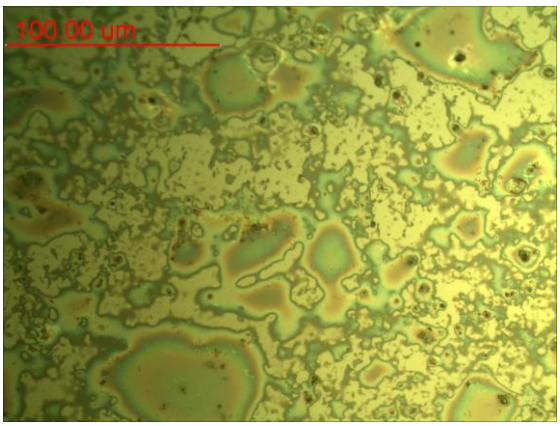
Abstract

Investigations on transfer methods of graphene on various III/V materials open a wide range of applications for the use of graphene e.g. as electrodes for bulk acoustic wave filter devices. In addition to an optimized graphene growth process via chemical vapor deposition (CVD) [1] an efficient transfer process from the metal catalyst for CVD to the target aluminum nitride (AlN) substrate is needed to provide an electrode material with the required characteristics. The standard floating transfer was developed on silicon oxide substrates. By contrast we evolved a floating transfer procedure onto target AlN substrates – this is due to a completely different behavior with regard to surface chemistry and adhesion a challenging task - to provide graphene with a wider field of application regarding relevant piezoelectric materials and wafer-scale technologies. Graphene sheets of up to 40x40 mm² were grown on Copper foil (Cu) and transferred to AlN. Due to III/V materials distinct surface properties a successful floating transfer includes an optimized target substrate surface treatment to maximize the adhesion between target substrate and graphene layer. This was done by a variation of surface plasma treatments, specific cleaning steps and a controlled desiccating sequence. In order to control the chemical reaction during the etching process of Cu, a strong dependence on the etching solvent concentration was found. A concentration optimization minimizes precipitate-induced defects in transferred graphene sheets occurring due to chemical side reactions of the etching solvent. We show an optimized floating transfer of 40x40 mm² graphene sheets on target AlN substrates. The development of graphene transfer on different semiconductor materials towards wafer-scale technologies opens a new range of applications for graphene as advanced electrodes, i.a. in the field of AlN-based radio frequency devices.

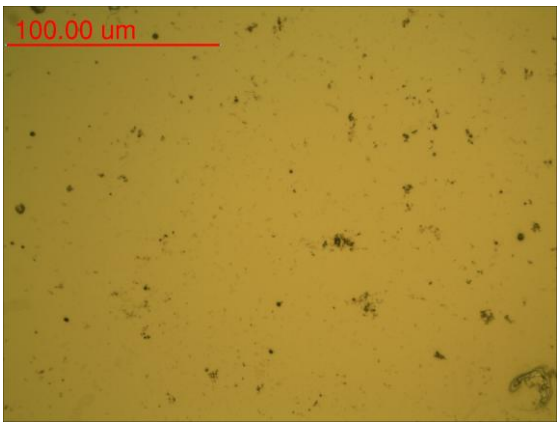
References

[1] X. Li, W. Cai, J. An, S. Kim, J. Nah, D. Yang, R. Piner, A. Velamakanni, I. Jung, E. Tutuc, S. K. Banerjee, L. Colombo, and R. S. Ruoff, “Large-area synthesis of high-quality and uniform graphene films on copper foils.,” *Science*, vol. 324, no. 5932, pp. 1312–1314, Jun. 2009.

Figures



Graphene on AlN - no surface treatment



Graphene on AlN - surface treatment, optimized deccidacting process