Improving the quality of a graphene film by process innovation

Seungmin Cho

Graphene is a mono-atomic layer of sp2 carbons and its extraordinary properties are attracting interests from industries of display, semiconductor and composites. The typical manufacturing process for large area graphene film include synthesis of graphene on a copper foil, lamination of graphene to carrier film, removal of copper foil, and dry transfer process. In this talk, recent advances on graphene synthesis, lamination/transfer and removal of copper foil are discussed.

A new equipment to reduce growth time for high-throughput and to achieve size, uniformity needed for industrial applications is designed and fabricated. Special attention is given to minimize thermal variations to provide uniform synthesis conditions. Higher ramp rate resulted in favorable effect on the morphology and microstructures of copper foil. As synthesized graphene gets larger, lamination and transferring process need to be customized.

Cu etching is one of the key processes to produce large-area graphene through chemical vapor deposition. The Cu etchant generally includes a strong oxidizing agent that converts metallic Cu to Cu^{2+} in a short period of time, which deteriorates graphene quality if not suppressed properly. The addition of metal-chelating agents such as benzimidazole (BI) to etching solution reduces the reactivity of Cu-etching solution by forming a coordination compound between BI and Cu^{2+}. The BI is well known as a heterocyclic molecular with strong electron affinity and excellent chemical and thermal stability.

The resulting graphene film exhibits a sheet resistance as lows as ~200 Ohm/sq. The improved electrical conductivity of graphene remained stable for more than 4 months at ambient conditions.