Large area graphene synthesis via novel ambient pressure chemical vapor deposition methods

Graphene has ignited strong interest from the scientific community ever since its discovery in 2004 by Professor Andre Geim and Professor Konstantin Novoselov from the University of Manchester, United Kingdom. This discovery won them the Nobel Prize in Physics 2010 for "groundbreaking experiments regarding the two-dimensional material graphene". The high attention toward graphene is due to its unique properties that have not been previously observed in other nanomaterials such as outstanding electronic properties, superior optical and mechanical properties as well as exceptional ability to conduct electricity and heat. The combination of these incredible properties allows it to be used, in the future, in myriad of applications such as sensors and biosensors, bioengineering, biomedical, composite materials, energy technology and solar cells. The discovery of graphene had brought forth new area of carbon nanomaterials after carbon nanotubes (CNTs). Since its discovery, research and technology innovations based on graphene has been rising exponentially.

One of the main roadblocks for the commercial application of graphene is the high cost involved in producing it. Though a process can produce high yield of graphene, it is still not desirable if the cost involved in producing it is high. Unlike graphene flakes, top-down method of breaking down graphite into large area graphene is not feasible. Chemical vapor deposition (CVD) has been recognized to be the most promising method for mass production of large area graphene because of its scalability and flexibility. Some of the factors that directly affect the production cost of large area graphene include recyclability, expensive environment and unused process effluent.

In our work, we approached this problem of high production cost from multiple angles. We reported the production of monolayer large area graphene via atmospheric pressure CVD by using a novel bimetallic catalyst. We also reported new techniques to recycle transition metal catalyst for both nickel and copper metal catalyst. Lastly, we also managed to co-synthesis large area graphene and syngas together from synthetic biogas which is a mixture of methane and carbon dioxide. All of our works focus on solving the graphene cost issue. Optimistically, one day it can be the seed that propel graphene towards commercialization.

References


