

Field:

Materials Science/Biomaterials

Session Topic:

Advances in Graphene-Based Science and Application

Chair:

Hiroki HIBINO, NTT Basic Research Laboratories

Graphene, a two-dimensional sheet of carbon atoms in a honeycomb lattice, is a building block of three-dimensional graphite, one-dimension-like carbon nanotube, and zero-dimension-like fullerene. The theoretical investigations of its physical properties go back to 1947, and since then many intriguing properties have been predicted. However, experimental investigations of graphene had to wait a long time. In 2004, Geim and Novoselov from the University of Manchester succeeded in mechanically exfoliating isolated graphene sheets from bulk graphite using adhesive tape and characterizing their electronic transport properties. This exfoliation method triggered a fever in the research of graphene-based science and technology. New physical properties and potential practical applications are now being revealed day by day.

Graphene creates a completely new class of two-dimensional material. In scientific fields, an especially exotic property is that the symmetry of the crystal structure means carriers in graphene are governed by relativistic quantum mechanical theory. Consequentially, unique physics, such as an abnormal quantum Hall effect and the Klein paradox, has already been proven experimentally. A small flake of graphene may offer a chance to study relativistic particle physics, which would normally require huge experimental facilities. Graphene also has potential for a vast variety of practical applications ranging from electronics to composites. Compatibility with standard planar lithographic techniques could play a crucial role in electronics/photonics applications. Graphene's huge carrier mobility at room temperature makes it promising for high-speed electronics applications. Flexible transparent electrodes could be more reachable for this strong, transparent, conductive material.

Graphene is a rising star in both science and technology. In reality, however, graphene experimental research has only just started. Graphene is a pure two-dimensional material and highly sensitive to the environment. Decoupling graphene from the environment is essential for exploring its ultimate properties, such as many-body effects in transport. Collaboration between theorists and experimentalists is now becoming more and more important for this new material. Though graphene has provided a variety of potentials for practical applications, no one knows the future exactly. Further, lots of work still has to be done for its industrialization, such as large-scale production and precise processing.

In this session, we will discuss why graphene is so interesting scientifically, what some of its potential practical applications are, and what we have to do in order to explore graphene's ultimate properties and to realize its potential.