Thermal Conductivity Measurement of Fluorinated Single-Layer Graphene

Masahiro Narasaki

Ph.D Candidate, Department of Aeronautics and Astronautics, Kyushu University

SRA, Thermal Science and Engineering Division

Abstract

Graphene is a two-dimensional material consisting of honeycomb structure of carbon atoms. The strong sp^2 bonding between the carbon atoms, lightness of the carbon atoms and planer structure lead to high thermal conductivity. Except for the thermal property, graphene exhibits high electron mobility and high transparency too, which are attractive to make graphene-based field effect transistor. The new transistor is expected to work with lower power consumption than conventional ones. In the graphene-based field effect transistor, one of the possible candidates of the gate insulator is fluorinated graphene. However, thermal properties of the fluorinated graphene have not been investigated experimentally. This lack of data makes it difficult to manage generated heat in devises efficiently. Here, we measured thermal conductivity of fluorinated single-layer graphene using a Au thin-film sensor. The sensor was fabricated by MEMS techniques. Fluorination of graphene was performed by exposing it to XeF_2 gas. The obtained thermal conductivity exhibit approximately 80 W/mK in the measured temperature range (310 K ~350 K), which is approximately 95% smaller than that of pristine single-layer graphene (~2000 W/mK). This big decrease is attributed to phonon scatterings caused by fluorine atoms and sp^3 bonding. When phonon (main thermal career) is scattered, its mean free path shortens, resulting in decrease of the thermal conductivity. This work lays a foundation for the study of thermal properties of functionalized graphene.