Measurement protocol for electrical characteristics of powder-type graphene materials

Ha-Jin Lee[1]
Haeseong Lee[2], Kyung Ho Park[3], Ji Sun Kim[1] and Mahfuza Mubarak[1]

[1] Western Seoul Center, Korea Basic Science Institute, Seoul 03759, Korea
[2] Dept. Nano and Advanced Materials Engineering, Jeonju University, Jeonju 55069, Korea
[3] Korea Advanced Nano Fab Center, Suwon 16229, Korea

hajinlee@kbsi.re.kr

Abstract

Graphene has attracted a great deal of attention as a next generation electronic material due to its extremely high mobility and ballistic transport of electrons. The unique properties of graphene are considered to be efficient candidates for use in electronic products such as transparent conducting films, electronic inks, supercapacitor, etc. Characterization of the electrical properties of graphene itself is essential to both manufacturers and users in order to develop innovative electronic devices or to improve existing electronic ones using it. Commercialized graphene products can be categorized by their manufacturing methods as follows: (i) graphene films grown by chemical vapor deposition (CVD), (ii) graphene sheets suspended in liquids, and (iii) graphene flakes in powder from. Many electrical properties of a powder-type graphene product are sensitively affected by its geometric and electronic parameters. Therefore, it is necessary to select the best representative parameter among its electrical properties which may exhibit the quality of graphene. There are many measurands to determine an electronic property of graphene flakes, e.g. sheet resistance, conductivity, resistivity, volume resistivity, and so on. Among them volume resistivity (or volume conductivity) was selected for the representative measurand which reveals the electrical property of powder-type graphene through a series of experiments. This work provides a standardized method for evaluating volume resistivity of commercial powder-type graphene flakes to enable users to select a product suitable for their applications.

References

[1] "Nanomanufacturing - Key control characteristics - Part 2-1: Carbon nanotube materials - Film resistance" IEC TS 62607-2-1 Ed 1.0 (2012)

[2] D. K. Schroder "Semiconductor material and device characterization" John Wiley & Sons, New York (1998)

Figures

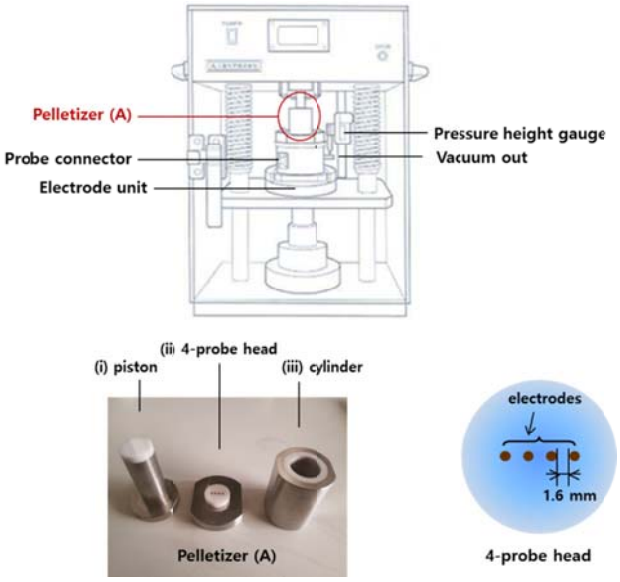

Figure 1. Schematic diagram of the measurement system and the photo of a pelletizer and 4-probe head.

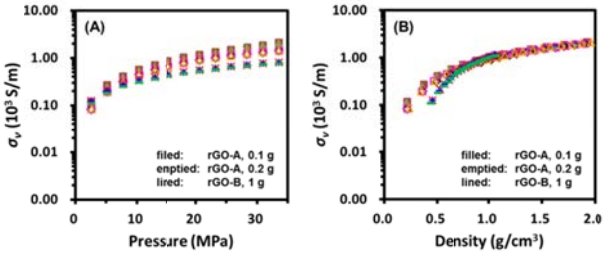

Figure 2. Plots of volume conductivity vs (A) the applied pressure, and (B) a density of reduced graphene oxide (rGO) pellets made of 0.1 g (filled), 0.2 g (emptied) of rGO-A, and 1 g (lined) of rGO-B.