Synthesizing Electro - conductive grease using graphite

W.A.P.P Christopher*, J.T. Cooray and A.N.B Attanayake
Faculty of Science and Technology, Uva Wellassa University of Sri Lanka

Introduction

Graphite as we all know is well renowned for its ability to conduct electricity as well as its lubricant nature. The carbon atoms in graphite are sp^2 hybridized. Each carbon atom bonds with three other carbon atoms via the three sp^2 hybridized atoms to form a sheet of carbon atoms lying in a hexagonal pattern or a honey comb structure and carbon atoms are bound together by strong covalent bonds. And each of these sheets of carbon is bound together by weak van der Waals bonds. The fourth electron in a p orbital is left free and its these electrons that contribute towards the electrical conductivity of graphite. Grease is a semi solid lubricant widely used in the industrial world to reduce ware and tare. Grease is made of three principal components known as a base oil, thickener and additives. Thus combining graphite with grease would preferably transfer the electro-conductive nature of graphite to grease forming an electro-conductive grease.

Usage of such a product would be, grounding static discharges, providing electrical continuity between irregular or pitted surfaces, ensuring electrical contact between loose or vibrating parts and small gaps, application to ball bearings in computer equipment where it allows static discharge to pass through the bearing instead of building up and arcing. Synthesizing such a graphite based grease product was the main objective of this study.

Materials and methodology

Natural vein graphite was used to make graphite powder under 75 microns. Basic grade grease was used as the substrate. Different weight ratios of both graphite and grease were mixed by blending to generate the sample series. The samples were tested for electrical conductivity using the impedance analyzer. A standard cell was made to hold the sample. The conducting length was kept to a minimum assuming that in real world applications (12 millimeters).

The cell electrodes were designed in such a manner that two over rings were placed to ensure that the effective conducting length was kept constant throughout the sample series tested. Three measurements were taken with each generating a graph of imaginary part of impedance versus the real part of it. And the resistance of the sample was determined by the point where the curve seemed to make contact with the x axis of the graph. And the capacity of the particular sample can be determined by finding out the frequency of the peak point of the semicircle.

$$2 = \frac{1}{\ldots\ldots\ldots\ldots} \quad \ldots\ldots\ldots\ldots (3)$$

$$= \frac{1}{\ldots\ldots\ldots\ldots (4)}$$

Thus,

$$2 = \frac{1}{\ldots\ldots\ldots\ldots (3) \& (4).} \qquad = \frac{1}{2}$$

Where,

c- Capacity, f- Frequency of the peak point of semicircle, R- Resistance of the peak point of semicircle.

Results and discussion

The samples show a near linear variation of both characteristics of conductivity and capacity. But the final sample containing 35% graphite with 65% grease shows a significant elevation in both conductivity and capacity. With a conductivity value of 4.2008 x 10^{-5} S cm^{-1} this particular sample is in the region of semiconductors with respect to conductivity.

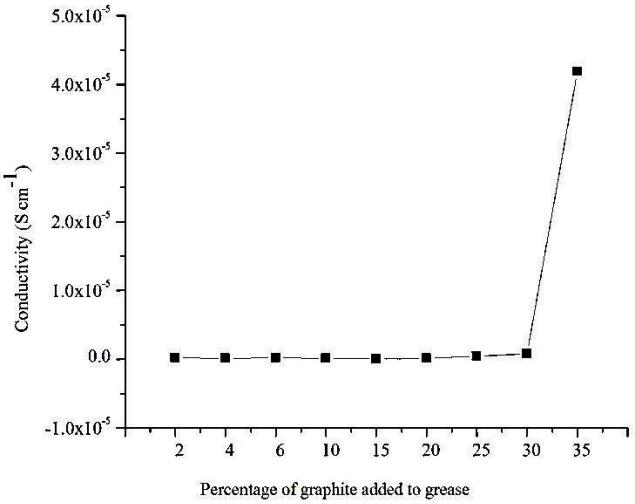

Figure 01: Conductivity variation of the sample series at room temperature

The figure 01 indicates a clear and significant elevation of conductivity for the sample containing 35% graphite with 65% grease while the preceding samples are scattered very closely with respect to their conductivity values. And the capacity of the samples vary almost linearly with the amount of graphite in them and shows a rapid increase when it come to the sample with 35% graphite according to figure 2 below. The capacity values change from Pico farads to Nano farads.

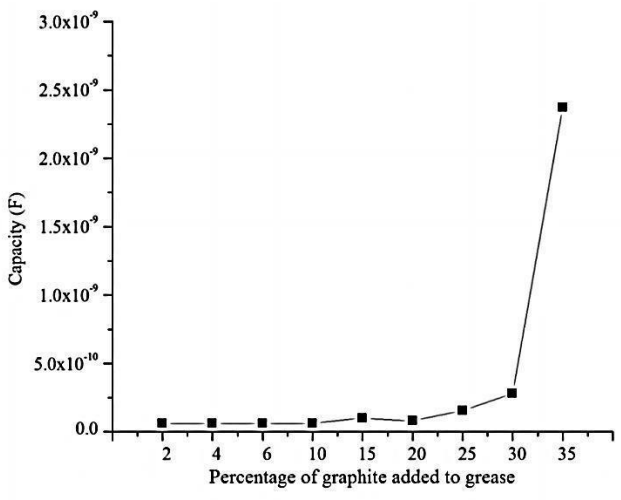

Figure 02: Capacity variation of the samples in room temperature

Conclusions

The samples show a near linear variation of both characteristics of conductivity and capacity. But the sample containing 35% graphite with 65% grease shows a significant elevation in both conductivity and capacity. With a conductivity value of 4.2008 x 10^{-5} S $cm^{-}1$, which puts it in the region of semiconductors with respect to conductivity ("Electrical Conductivity: Range of Conductivity." *Encyclopaedia Britannica*. N.p., n.d. Web. 10 July 2014). And all the samples resembled a parallel plate capacitor connected to a resistance parallel, implying that they had a capacity to store static charges. And all these characteristics are in favor of the product with respect to its uses.

References

Encyclopaedia Britanica (2014), Electrical conductivity: range of conductivity. Retrieved July 10, 2014, from the World Wide Web:
http://www.britannica.com/EBchecked/media/139/Typical-range-of-conductivities-for-insulators-semiconductors-and-conductors.html