Dr. Flint weighs in on Graphene

For many years now graphene has been one of the largest fields of research and “graphene” products are beginning to enter commercial markets. Graphene has become a marketing term that denotes the something other than traditional graphite fiber or carbon black. However, the products that you think have graphene are probably using graphite as the “graphene” used in their development and fabrication often contains only traces of true graphene.

The graphene research has concentrated on both forms of graphene: take down and build up.

Build-up graphene is a constructed layer of graphene typically built on a sheet of copper by the decomposition of CO2 or methane. These sheets are then transferred to different media. The costs of this type of graphene is high. Thus, the number of successful applications that use this method have been limited to electronics or other very small surface area applications. Examples are graphene based lights. Graphene sheets that have various chemically produced holes in their lattice, or that have different chemical groups attached to them, do show potential for gaseous detection or specialized filters. Many companies with multimillion dollar graphene development projects, which use this type of graphene, have not performed; not because the applications didn’t work but because they were not economic. Outside of electronics, build up graphene has proven to be too expensive.

Take down graphene is formed by peeling layers from graphite and is much less expensive to make. There are many processes that “supposedly” create graphene in this way. These include microwaves, plasmas, and other forms of exfoliation. These do result in graphene but generally only a few percent. Usually

these products contain less than 20% graphene and the often contain less than 5%. There are two known examples that are better; at 54% and 90%. The graphene created this way is often termed graphene platelets or graphene nano-platelets (GNP) and have a lateral dimension of approximately 0.1 to 4 micrometers with between one and nine layers. Generally, the sales value of this graphene falls in the range of $40 to $200 a gram.

The graphite that is not converted to graphene by these processes is termed graphite platelets. Generally, these failed particles have the same dimensions as graphene but have between ten and thousands of layers. The value of graphite nano-platelets is usually between $2 and $20 per gram.

Both graphite and graphene platelets are often described using the word ‘nano’ leading to both using the acronym (GNP). Whether on purpose or not, it does lead to significant confusion.

Unless the research is being done using one of the few sources that produces high percentages of graphene actual performance of the products is based on the characteristics of the graphite platelets; the vast majority of applications, developed to date, actually use the nano-platelet graphite. Either form of these platelets can increase the heat and electrical conductivity of composites, or inks, and improve physical strength when compared to many other fillers. Popular applications are the replacement of carbon black with either form of these particles. Examples are tires and plastic composites used for making tennis rackets and hockey sticks or many of the “graphene” inks. What is labelled graphene is usually not. However, these are valid applications that deserve the attention that they get, albeit as graphite and not graphene as they are often labelled. However, despite the marketing, the major revolution of graphene is yet to occur, and will not occur until there is a reliable, low cost supply of high quality graphene.