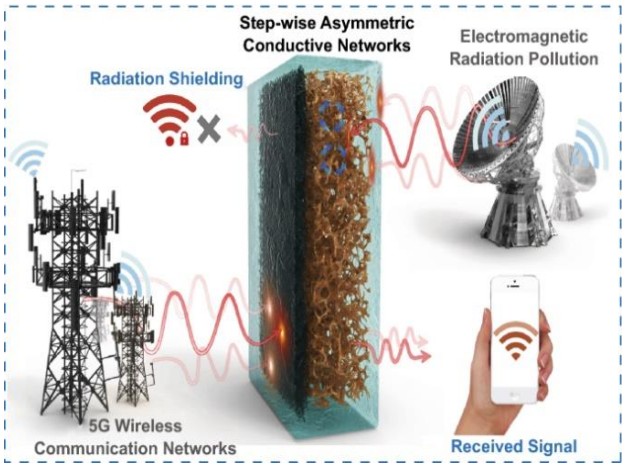
Development of Graphene nano-composites for EMI Shielding Applications

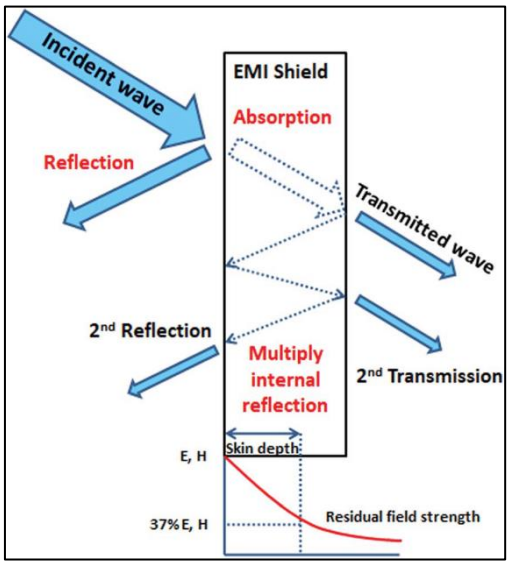
The term EM shielding usually refers to the method to guard or shield the electronic and cables with conductive and magnetic materials against incoming or outgoing emission of electromagnetic frequencies (EMF). In today's world, we are surrounded by electronic and electrical gadgets, the boundless use of these devices leads to a sort of pollution called electromagnetic interference (EMI) or Radio frequency Interference (RFI). EMI ruined or degraded the normal functionality of the electronics and electrical devices and also adversely affects the health of human beings. Hence EMI received much attention of the scientific community and becomes a serious concern to protect our systems from this unavoidable phenomenon. The government has also put regulations to control the level of electromagnetic radiations in the environment and made several efforts to reduce its effects by using microwave absorbing materials (MAM). Therefore, shielding of our electronic and electrical systems as well as our body from these radiations has becomes an essential requirement of modern society.



With the fast expansion of electronic information and technology, especially in stealth, electronic devices, high frequency communication, information processing technologies etc., microwave absorbing materials (MAM) and electromagnetic interference (EMI) shielding materials have received considerable interest.

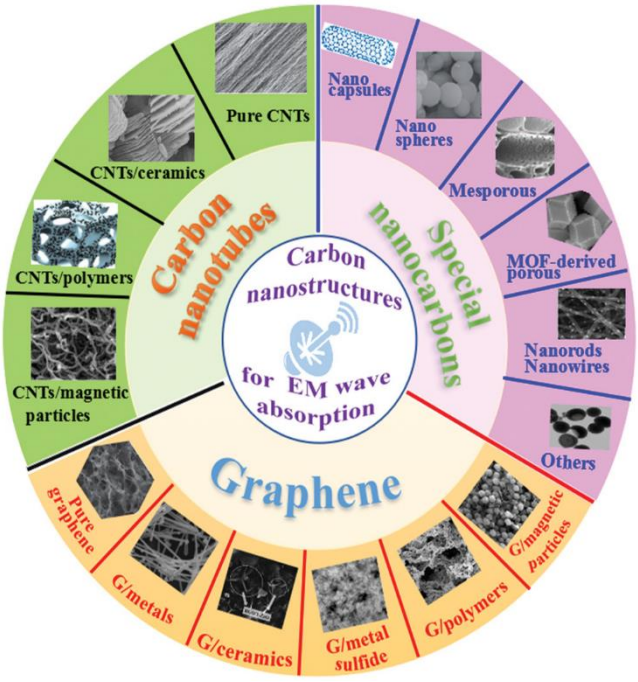
EMI shield normally performs two functions; first to prevent emissions from the electronics of the equipment or to protect that electronics portion from the radiation from outside boundaries of the product. The second function of the shield is, to protect the product's electronics from the incoming radiations from the outside source to

couple with the product electronics that may cause interference in the product. Hence, an EM shield is conceptually, a barrier to the transmission of the electromagnetic radiations.



Schematic for EMI shielding mechanism

In recent years, the development of high-performance EM wave absorption materials being lightweight, and having thinness, broadband, and strong absorption became the most important targets. Until now, some dielectric or magnetic loss materials have played a vital role in high-frequency EM wave absorption. However, the shortcomings including high density, weak absorption performance, and narrow absorption bandwidth have greatly restricted traditional loss materials' practical applications for EM wave absorption. Nowadays, novel EM wave absorbents are emerging and exhibit outstanding EM wave absorbing properties. Carbon nanostructures have low density, high specific surface area, high permittivity, and excellent electronic conductivity. Therefore, the carbon nanostructures are often designed to meet the demands of high-performance EM wave absorption material.

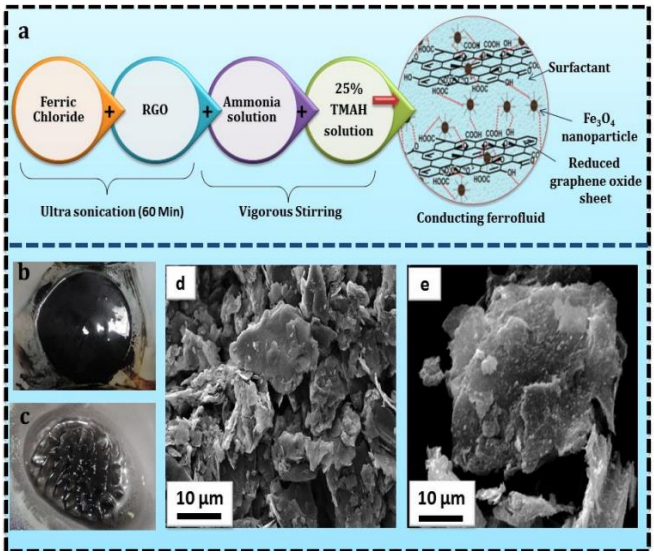


Carbon nanostructures and their composites for high frequency EM wave absorption

Usually, the carbon nanostructures for EM wave absorption can be mainly divided into three categories: graphene, CNTs, and other special carbon nanostructures. As the most typical two-dimensional carbon nanostructures, graphene has sparked extensive interests in EM wave absorption owing to its excellent electron mobility, high thermal conductivity, excellent mechanical properties, and high specific surface area.

The EM wave absorption of carbon nanostructures are contributed to its dielectric loss. The non-magnetism of carbon nanostructures limits their EM wave absorption efficiency. Therefore, various nanocomposites based on carbon nanostructures and other lossy materials could be modified as high-performance EM wave absorption materials. The nanocomposites based on carbon nanostructures can make for better impedance matching, improve the EM wave absorption property, and reduce the density. Furthermore, the designs of nanocomposites based on carbon nanostructures are introduced for high-performance EM wave absorption materials.

Research is being initiated in the company on designing of nano composites which can be used as an effective shield for electromagnetic radiations in microwave region as well as for the frequencies for 4 G & 5 G network.



Schematic representation of the synthesis of conducting nanoferrite encapsulated with Graphene oxide (a) Photographs of conducting nanoferrite (b & c) with and without the presence of an external magnet, respectively, (d) shows SEM micrograph of RGO sheets and (e) shows SEM micrograph of conducting nanoferrite encapsulated with RGO.