FERRO REFRATECH
HIGH PERFORMANCE REFRACTORIES
Works and Office:
Plot no. C18 (P), Phase IV, Adityapur Industrial Area,
P.O. Gamharia, Dist: Seraikella Kharsawan – 832108, Jharkhand.
Email :ferro.refra@gmail.com, Phone : 9934177797 / 9204933363
PAN NO.: AAFFF0508H, GSTIN : 20AAFFF0508H1Z5

Owing to its ultrathin, two-dimensional (2D) nature and its unprecedented properties, **GRAPHENE** has become the most studied of nanomaterials. In the next 10 years, graphene will find commercial applications in many areas from high frequency electronics to smart coatings. Some important classes of applications, such as printed electronics, conductive coatings and composite fillers, will require industrial-scale production of defect free graphene in a processable form. For example, graphene is likely to be used as a low-cost electrode material in applications such as solar cells, batteries, sensors, anti-corrosive paints as well as lubricants. **Ferro Refratech** is the manufacturers of different grades of Graphene, Graphene Oxide, Reduced Graphene oxide (RGO), Graphene composite, Slurries, Paints etc. as per requirements and applications. Graphene F and Graphene R the two different types of synthesised at **Ferro Refratech**. The test Reports of which are given below.

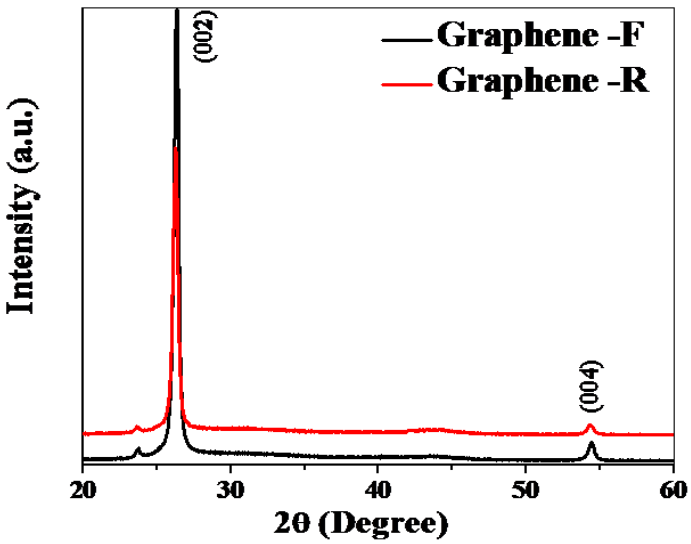


*Fig. 1: XRD data of Graphene F and Graphene R*

Form Fig. 1 the 100% phase pure graphitic phase is confirmed for Graphene F and Graphene R.

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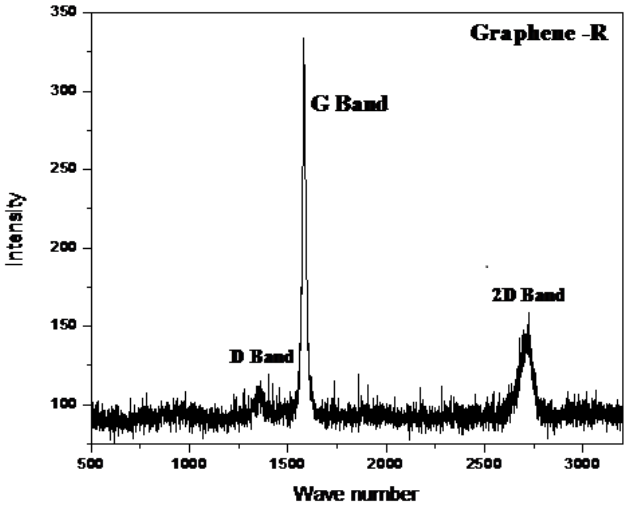


*Fig. 2: Raman spectra of Graphene R*

For any 2D material Raman spectroscopy is the best characterization tool. Raman spectroscopy of Graphene R is shown in Fig. 2. From Fig. 2 , Intensity of 'D band' is 114 and that of G ,2D are 335 and 158, respectively. So, ID/IG ratio is 0.34 which depicts the multi layer Graphene. I2D/IG ratio is 0.47 resulting multi layer Graphene. The same was observed from the instanano software the result of which attached in Fig.3 Generally 5-10 layer Graphene is called multi layer Graphene [https://doi.org/10.3390/ma14164590].

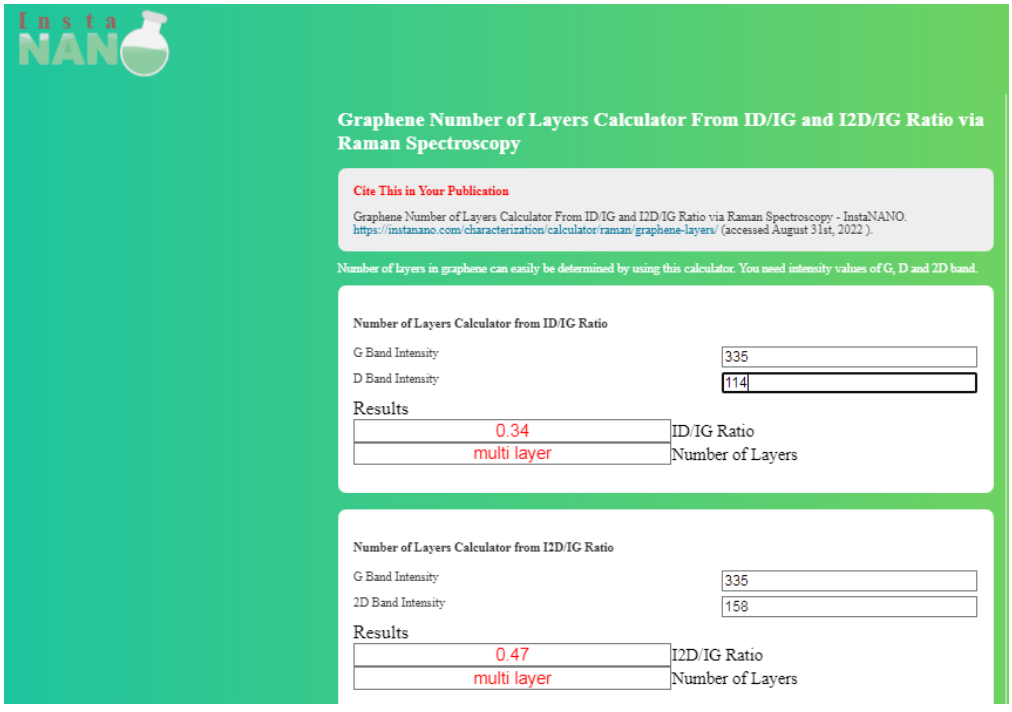


*Fig.3 : The no of layer calculation for Graphene R from Instanano software.*

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Fig 4 (a,b) and (c,d) are shown the FESEM and TEM photomicrographs, respectively of Graphene R. From FESEM photomicrograph 5 layers of graphene are clearly seen and that was confirmed from TEM images [Fig. 4(c,d)].

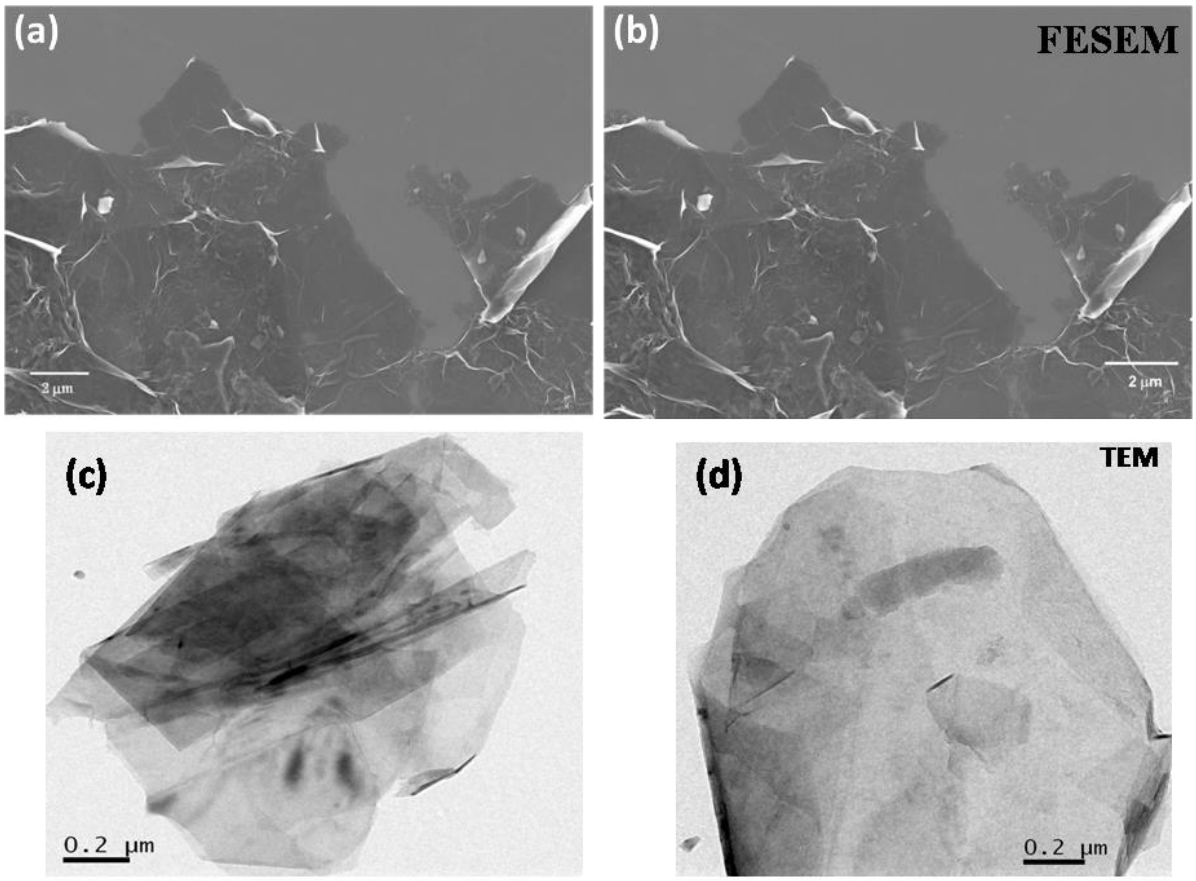


Fig. 4: electron microscopy of Graphene R (a,b): FESEM photomicrograph and (c,d): TEM Photomicrograph.

So, 5 layers Graphene is confirmed for **GRAPHENE R** from the aforesaid characterizations.

Figure 5 depicts the Raman spectra of Graphene F.

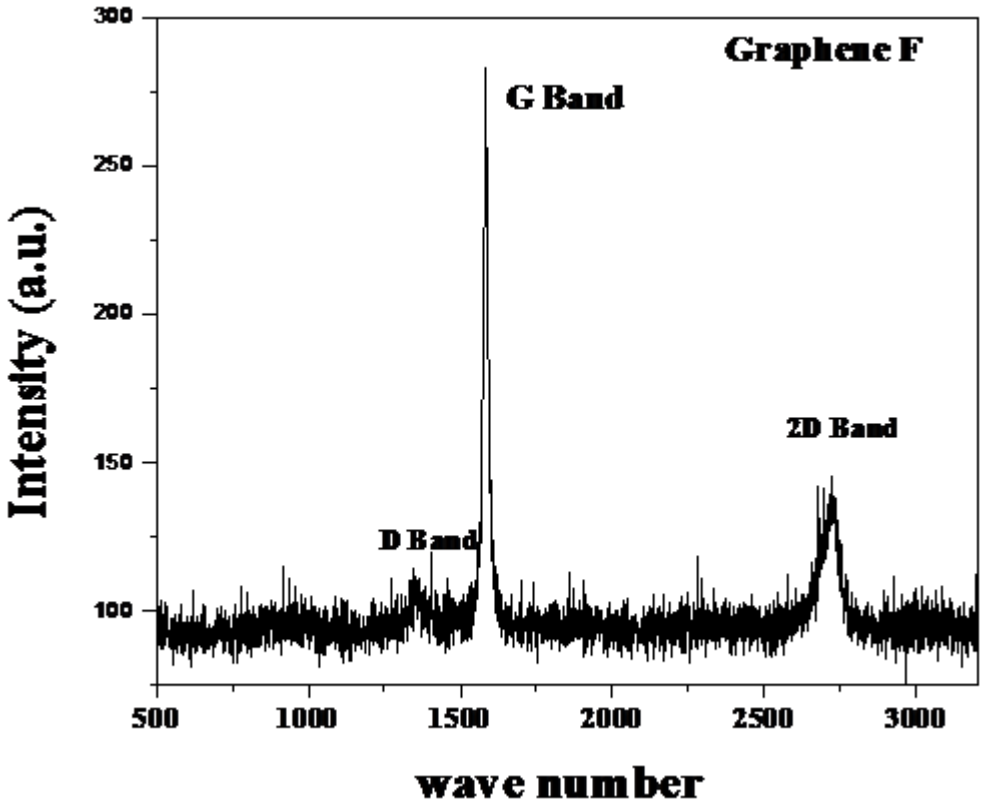


*Fig. 5: Raman spectra of Fraphene F*

From Fig. 5 , Intensity of 'D band' is 112 and that of G ,2D are 285 and 146, respectively. So, ID/IG ratio is 0.39 which depicts the multi layer Graphene. I2D/IG ratio is 0.51 resulting multi layer Graphene. Same result was observed from Instanano software, Fig. 6.

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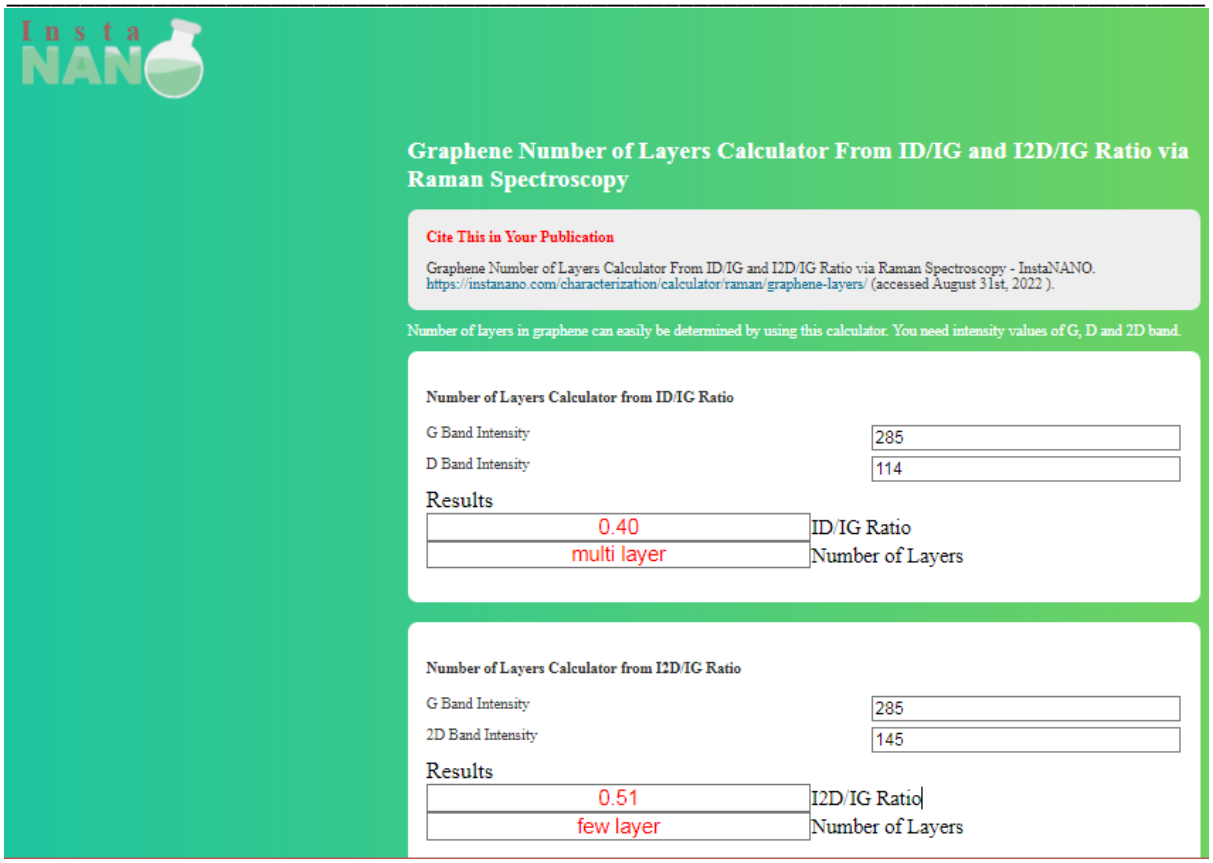


*Fig.6 : The no of layer calculation for Graphene F from Instanano software.*

Fig 7 (a,b) and (c,d) are shown the FESEM and TEM photomicrographs, respectively of Graphene F.

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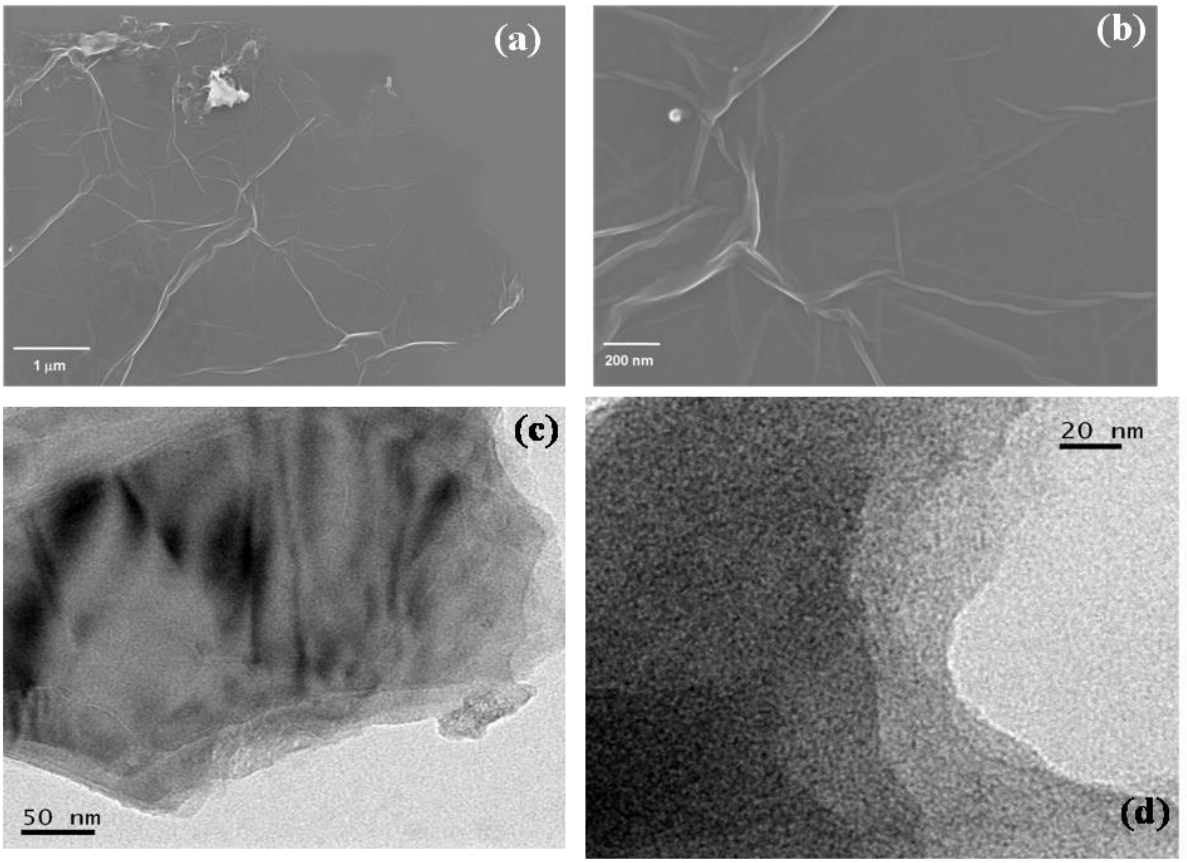


*Fig. 7 (a,b): FESEM photomicrograph and (c,d): TEM photomicrograph of Graphene F.*

From FESEM photomicrograph [Fig.7 (a,b)] 10-15 micron diameter Graphene sheets are confirmed but 4 to 5 layers of graphene sheets are clearly seen from TEM images [Fig. 7(c,d)].

**So it can be concluded that Graphene R and Graphene F are 100% phase pure 5-10 and 4-10 layers Graphene, respectively.**

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