Photocatalytic Degradation of Congo Red Dye Using Graphene-BiFeO3 Nano Composite: Enhancing Secure Communication with Blockchain Technology.

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Abstract :

This abstract highlights the photocatalytic degradation of Congo Red dye using a graphene-BiFeO3 nano composite. The study investigates the potential of the composite material for efficient degradation of organic dyes through photocatalysis. Additionally, the abstract explores the application of blockchain technology in enhancing secure communication. By integrating blockchain into communication systems, data integrity, privacy, and security can be enhanced, ensuring reliable and trusted communication channels. The combination of advanced photocatalytic materials and blockchain technology presents promising opportunities for sustainable and secure communication in various domains.

SYNTHESIS PROTOCOL OF PURE AND COMPOSITE VERSION OF $BiFeO_3$

Sigma Aldrich's 99.9% pure raw materials will be used in their entirety. To make the material, stoichiometric volumes of bismuth nitrate penta were dissolved in distilled water while being agitated and heated to 80 °C. Bi loss during synthesis was accounted for by employing a modest amount of bismuth nitrate. After 10 minutes, stoichiometric quantities of iron nitrate nanohydrate were added to the aforementioned solution. A few drops of HNO3 solution were added. The solution was heated while being continually agitated until a gel formed then dried in an air oven. After that, the powder was annealed for two hours at 550 degree Celsius. To prepare the composite material optimized amount of BFO powder and graphene powder was ultasonicated at frequency 20 KHz in solution containing ethanol and DMF.

RESULT AND DISCUSSION

Fig 1 shows the XRD patterns of BFO. Fig 1 revels the XRD profile pure BFO which confirms the formation BFO material. The XRD peaks of BFO could be indexed with rhombohedral lattice with R3c space group[16, 17]. Besides of pure phase some impurity phase also has appeared. The small intensity peak near two theta at 27 belongs to oxygen rich impurity $Bi_{25}FeO_{40}$

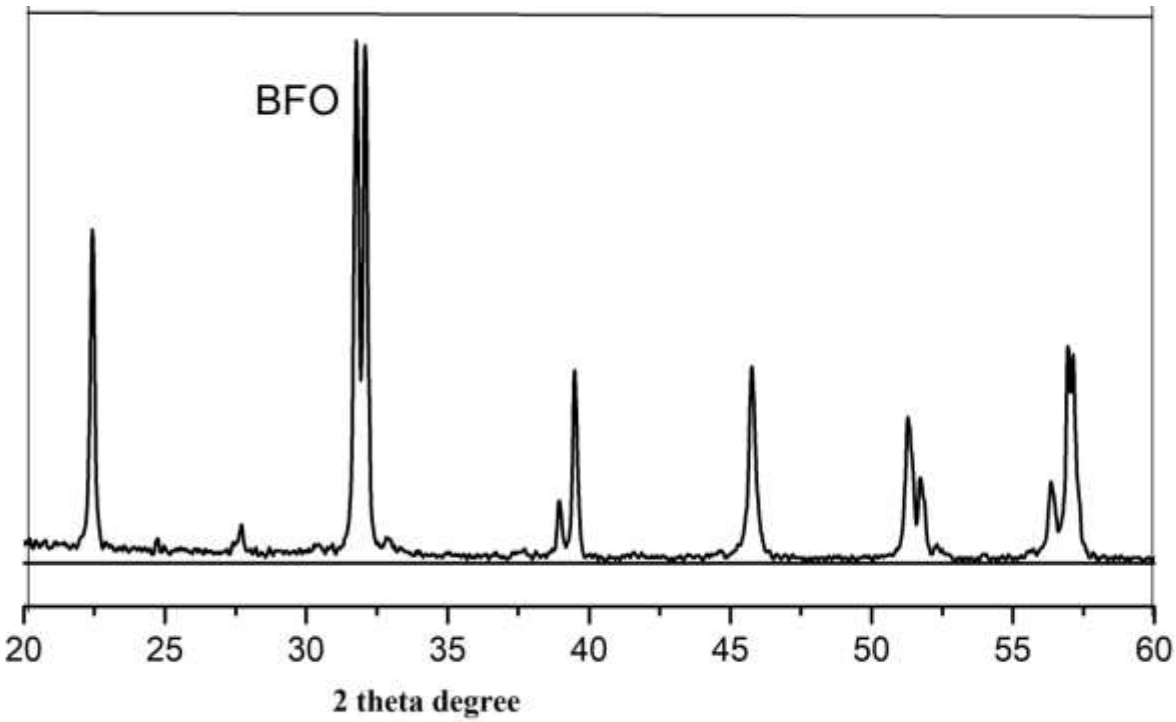

Fig: 1 XRD pattern of BFO

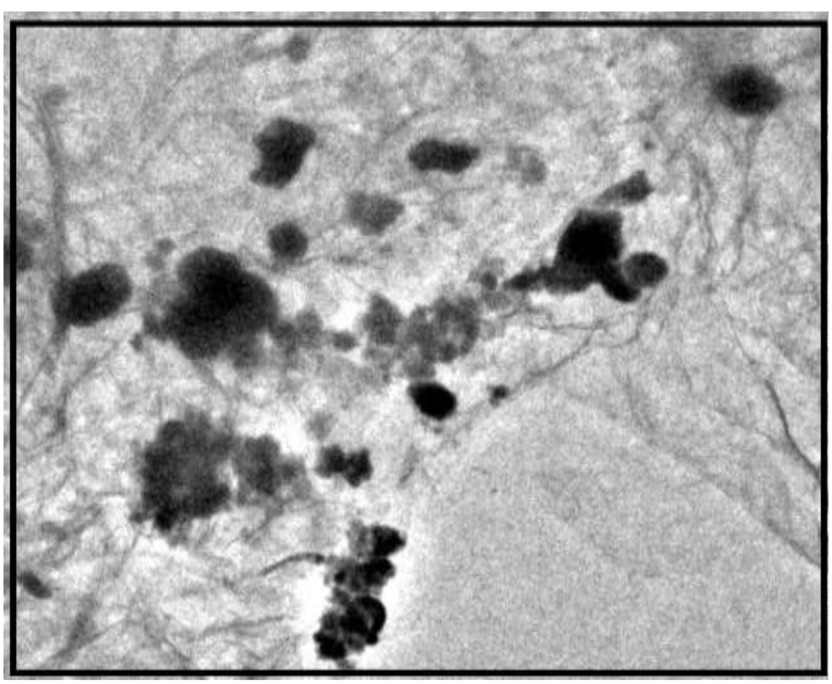

Fig: 2 XRD Scanning electron micrograph of graphene-BFO composite

Microstructure analysis of graphene –BFO composite was done by scanning electron microscopy technique which is shown in Fig: 2. Micrograph clearly shows that the BFO nano particles are well anchored on graphene sheets. The average particle size of graphene was found to be nearly 100nm. Wrinkled shaped graphene sheet could be clearly seen in the micrograph.

In order to investigate the dye degradation efficiency of the prepared photocatlyst, we have prepared congo red dye solution in distilled water. The concentration of dye was taken is about 0.1g per liter. Very small amount of catalyst was added in the prepared solution of congo red dye and then solution exposed under UV- Vis radiation. We have taken the spectrum of resulting solution prior to exposure and after exposure in definite interval which is shown in Fig 3.

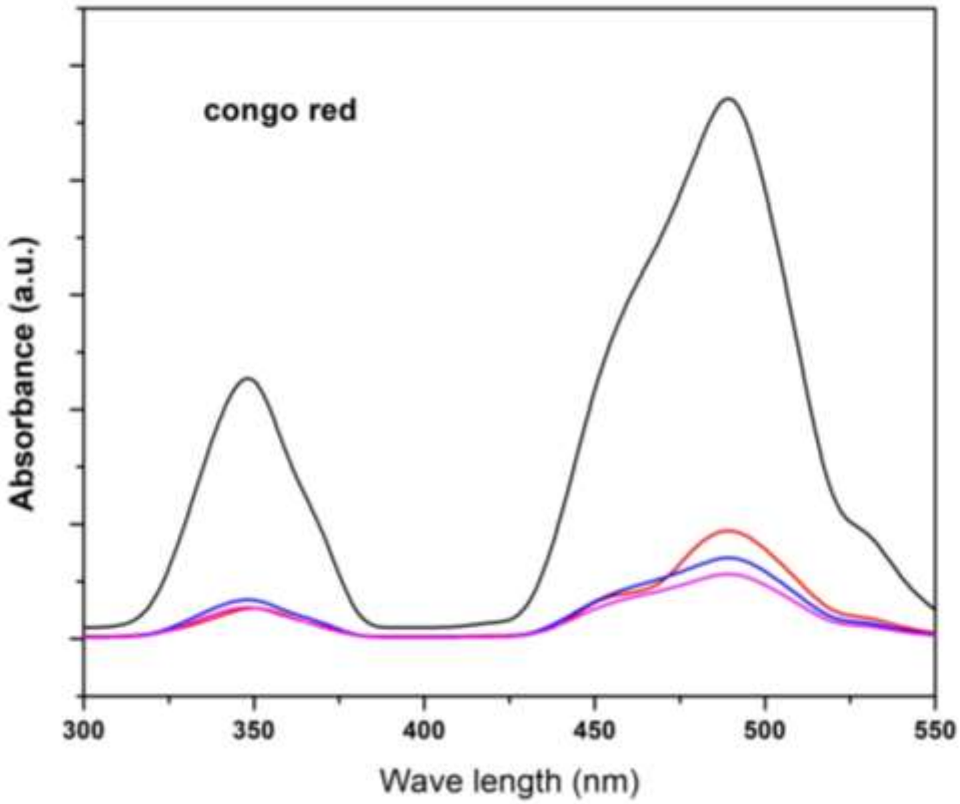

Fig: 3Uv-Vis spectrum of of graphene-BFO composite before and after irradiation of light

Fig 3 shows after irradiation of light the absorption decreases significantly which confirms that the degradation of dye occurs. Hence, the prepared material is showing good photocatlytic activity under the visible light irradiation. In order to determine the degradation efficiency we have measured C_t/C_0 ratio with time of irradiation which is shown in Fig: 4.

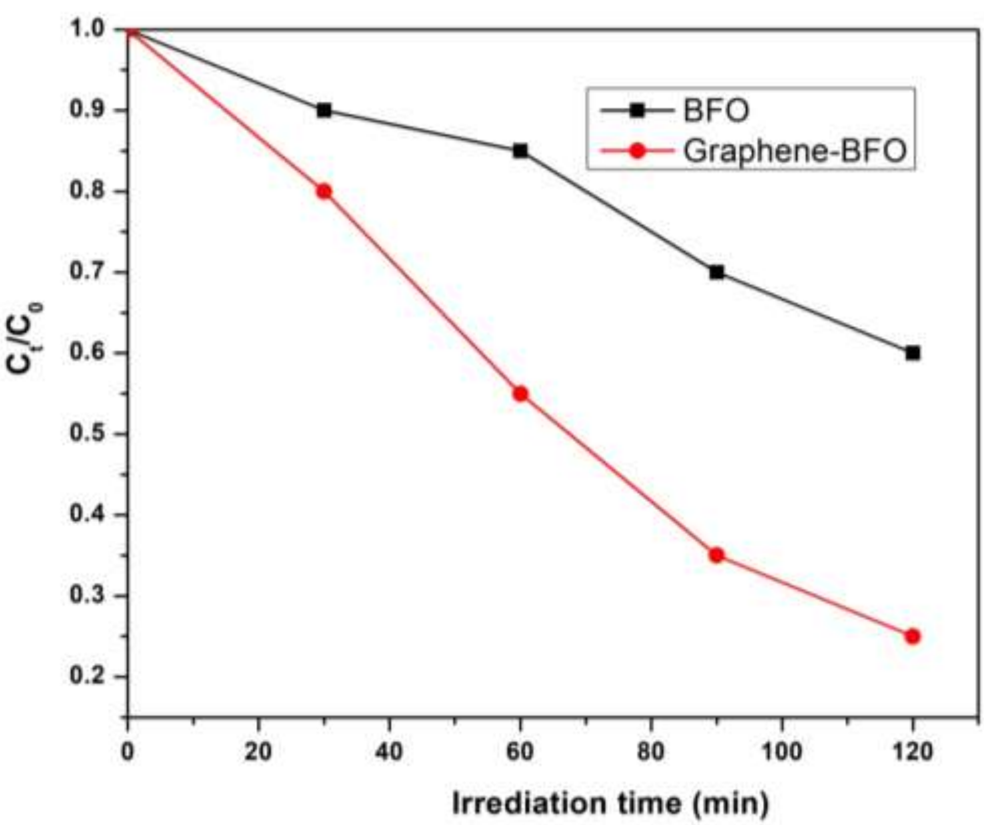

Fig: 4 Dye degradation efficiency of BFO and graphene-BFO composite under the irradiation of light

From Fig: 4, it is confirmed that the pure BFO degraded 40% of dye after 120 min of irradiation whereas Graphene-BFO composite degraded 75% of dye in same time. These results are in favors that Graphene- BFO composite has better photocatlytic activity than pure BFO.

CONCLUSIONS

We have successfully prepared pure and graphene- BFO composite by low temperature sol gel and ultrasonication method.All of the produced materials were subjected to a variety of characterisation procedures. Following an extensive comparison investigation, we shown that the composite material may lead to an increase in the photocatalytic activity of semiconductor material. We have demonstrated that graphene-BFO composite material had greater photocatalytic activity than pure graphene.

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