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INVESTIGATION OF TiO_2/3D FREE-STANDING GRAPHENE NETWORKS

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SCOPE

- Graphene networks (GN) obtaining by CVD on nickel foam substrate.
- TiO_2/3D free-standing graphene networks developing by using electron beam evaporation from TiO_2 granules to deposit titanium dioxide directly on the graphene networks.
- TiO_2/3D free-standing graphene networks could be further used in photocatalysis, energy storage and a wide range of other applications.

EXPERIMENTAL

- Graphene networks were prepared by using nickel foam as the template in a CVD process at ambient pressure and 1000°C with methane as carbon source at atmospheric pressure for 60 minutes. In order to obtain the freestanding 3D graphene networks (3DGN), we proceeded to nickel foam etching in hydrochloric acid.
- TiO_2/3D free-standing graphene networks (3DGN-TiO_2) were developed using electron beam evaporation from TiO_2 granules to deposit titanium dioxide directly on the graphene networks.
- TiO_2 thin films were deposited by e-beam evaporation in a vacuum optical VU-2M installation (Russia). Titanium dioxide pieces of 99.99% purity, 1-4 mm, produced by Kurt J. Lesker Company were used for evaporation. The deposition was performed at room temperature at a pressure of $1x10^{-2}$ Pa and an oxygen flow rate of 70 sccm, at a deposition rate of 0.5-1 Å/s and a rotation speed of 10 rot/min. The deposition thickness was 100 nm (~23 minutes deposition time), respectively 200 nm (~40 minutes deposition time).

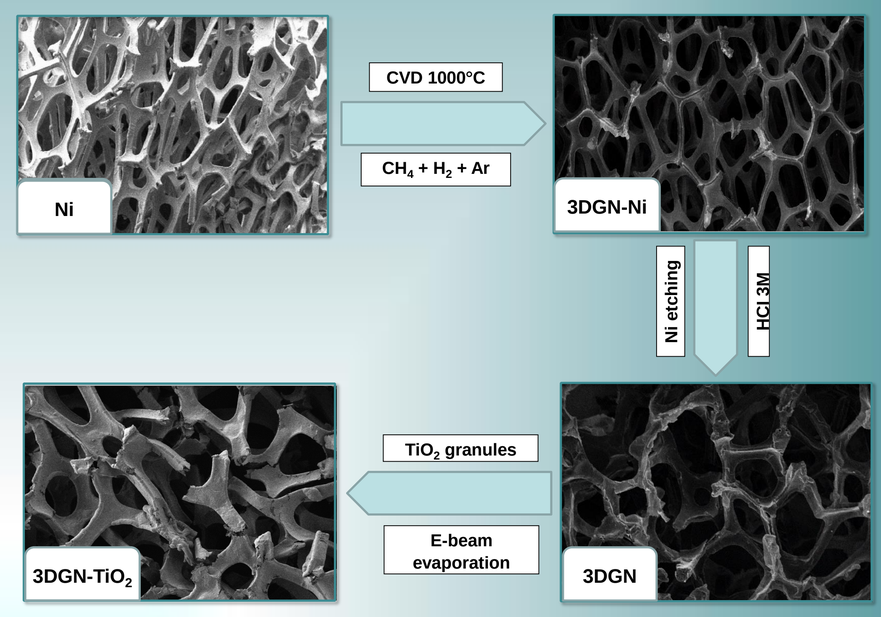

TABLE 1. CVD process conditions for graphene networks preparation

Sample	Growing time (minutes)	Growing temperature (°C)	CH_4 flow rate (sccm)	H_2 flow rate (sccm)	Ar flow rate (slpm)
3DGN	60	1000	200	325	2

RESULTS

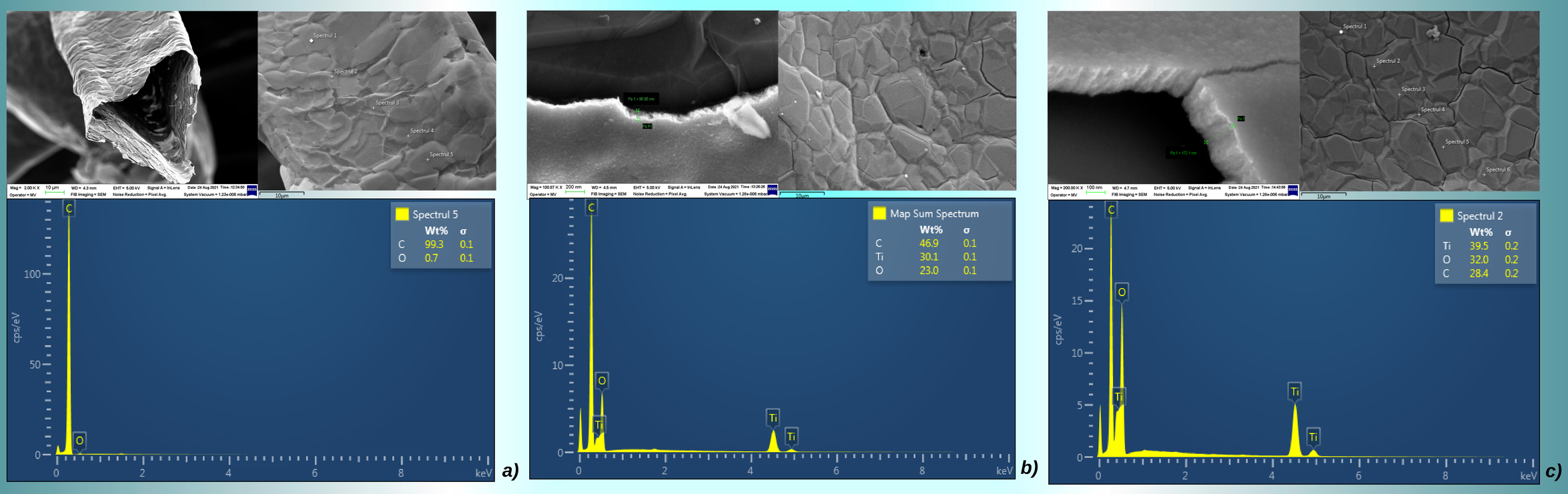

FIG. 1. SEM images and EDX of: a) 3DGN; b) 3DGN-TiO_2-100; c) 3DGN-TiO_2-200

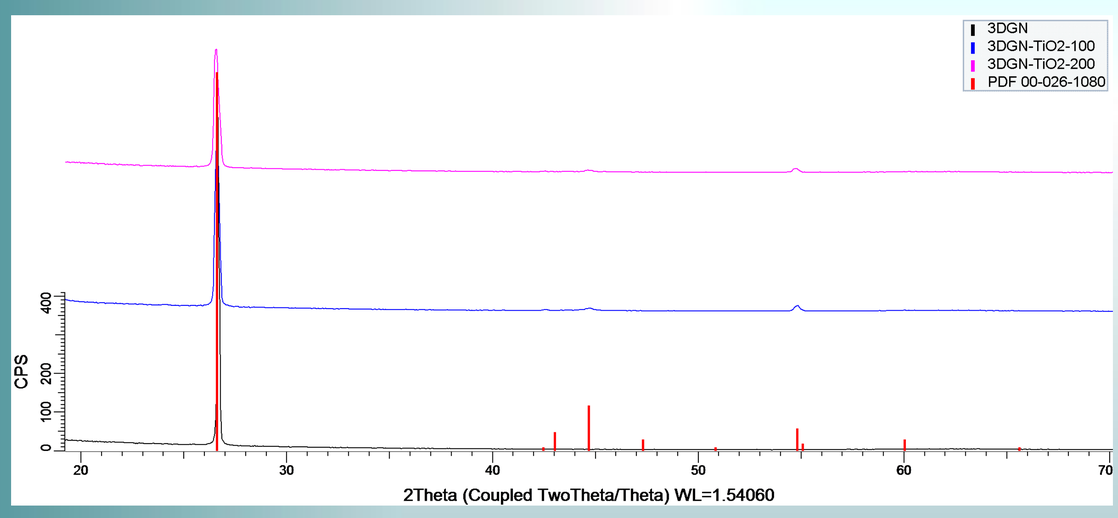

FIG. 2. XRD pattern recorded on 3DGN, 3DGN-TiO_2-100, 3DGN-TiO_2-200

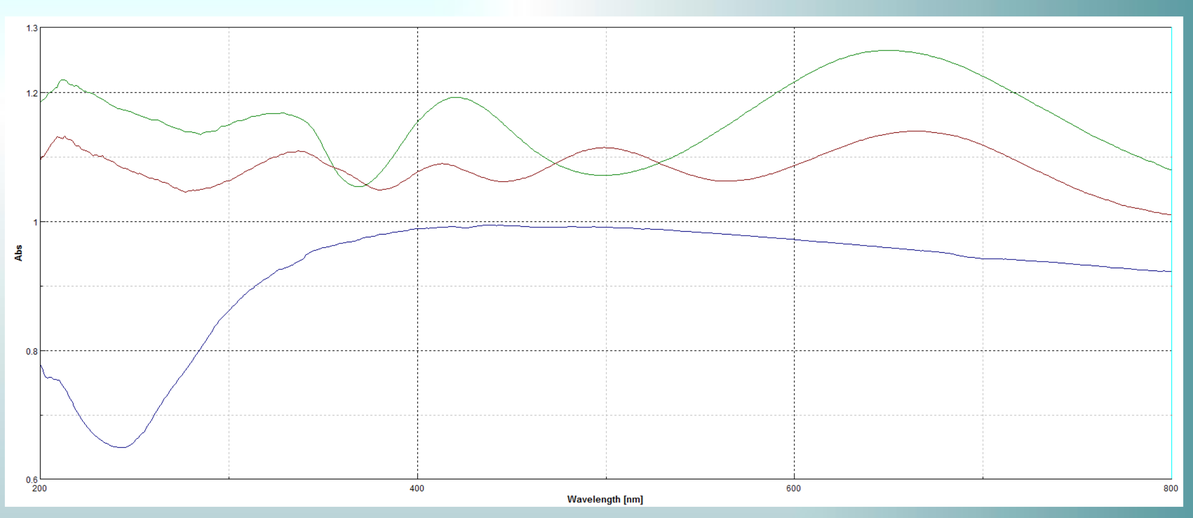

FIG. 3. UV-visible absorption spectra recorded on 3DGN (blue), 3DGN-TiO_2-100 (red), 3DGN-TiO_2-200 (green)

CONCLUSIONS

- TiO_2/3D free-standing graphene networks (3DGN-TiO_2) were successfully obtained by using a complex process that implies the electron beam evaporation technique to deposit titanium dioxide films directly on the graphene networks prepared previously by chemical vapour deposition on nickel foam.
- From the XRD pattern it can be seen the specific diffraction peaks of graphene, but the TiO_2 films are amorphous and very thin and they could not be detected.
- SEM images and the EDX spectra reveal the presence of amorphous TiO_2 thin films at the surface of the graphene networks.
- By analyzing the UV-Vis spectra we found that the TiO_2/3D free-standing graphene networks present the specific peaks of TiO_2 and graphene in the range of 400-500 nm.
- The absorption spectra of the TiO_2/3D free-standing graphene networks are much higher than that of the 3DGN for all UV-Vis region.
- The TiO_2/3D free-standing graphene networks will be further heat treated in order to obtain crystalline TiO_2 thin layers for photocatalytic applications.

ACKNOWLEDGEMENT

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