MICROWAVE SYNTHESIS OF ANTIMONY OXIDE GRAPHENE NANOPARTICLES – A NEW ELECTRODE MATERIAL FOR SUPERCAPACITOR

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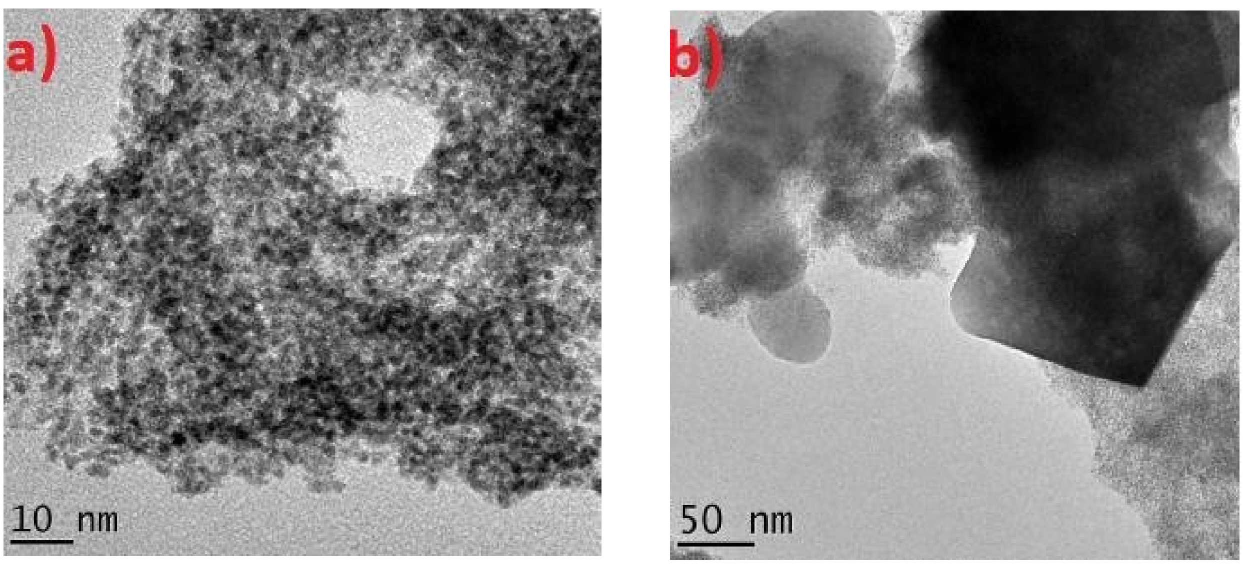

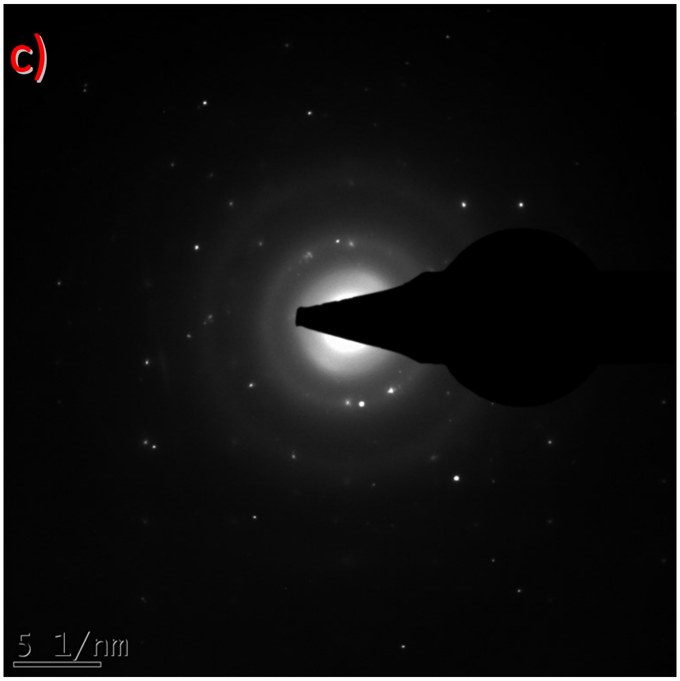

Figure 1: SbO: a,b) TEM images at different magnifications; c)SAED pattern showing different spots

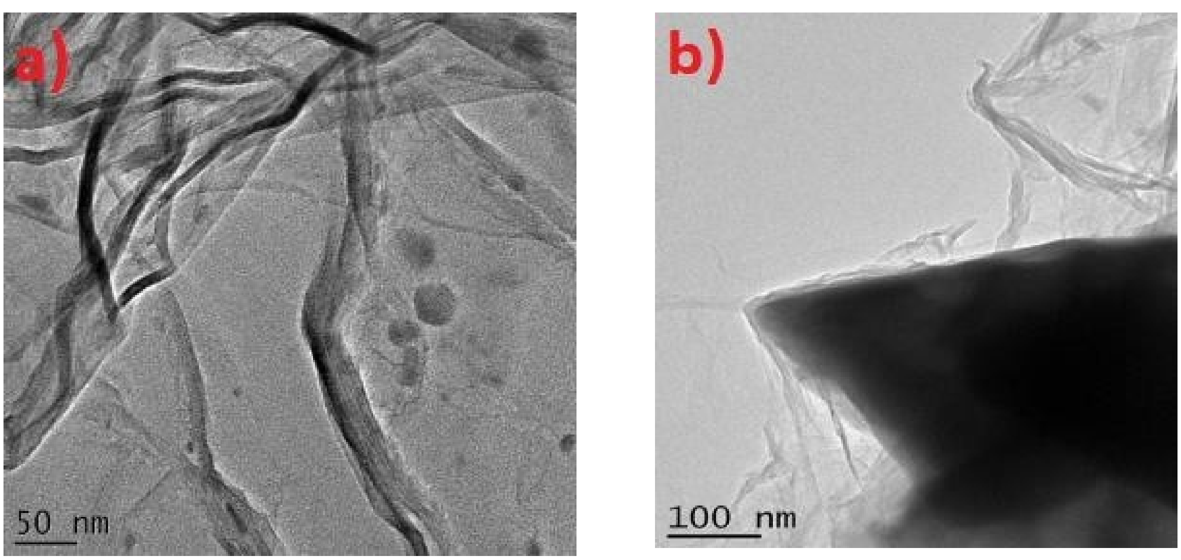

Figure 2: SbO-G: a,b) TEM images at different magnifications

Atomic force microscopy

Atomic force microscopy (AFM) is an important tool for examining surface topography and roughness parameters of materials. The AFM micrographs of SbO films deposited on screen plated electrodes are shown in Figur, and Figure. The surface topography of the SbO and film shows that grains are uniformly distributed, without any fractures or voids in the film's surface. The thin film surface roughness was also derived from AFM investigations. The root mean square roughness (Rq) and the average roughness (Ra) were found to be 68.4 nm and 56.2 nm, respectively. Table is the list of all parameters obtained from the AFM analysis[14].

Table 1: AFM parameters for SbO and SbO-G

Parameters	SbO (µm)	SbO-G (mm)
Ra	1841.8	6.153
Rms/Rq	51657	6.848
Surface area	1448	6.05

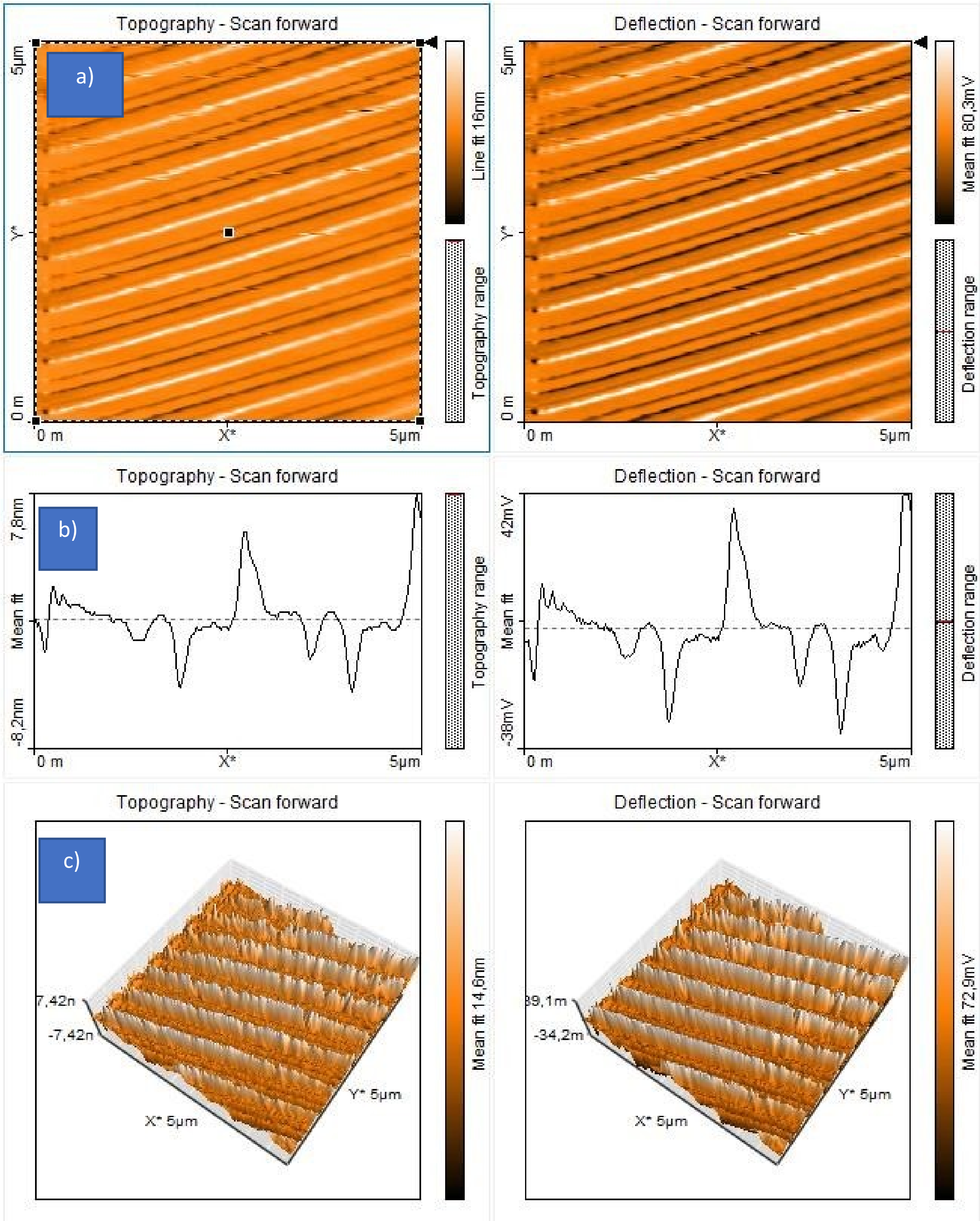

Figure 3: AFM a) 2D, b) line and c) 3-D topography and deflection images of SbO.

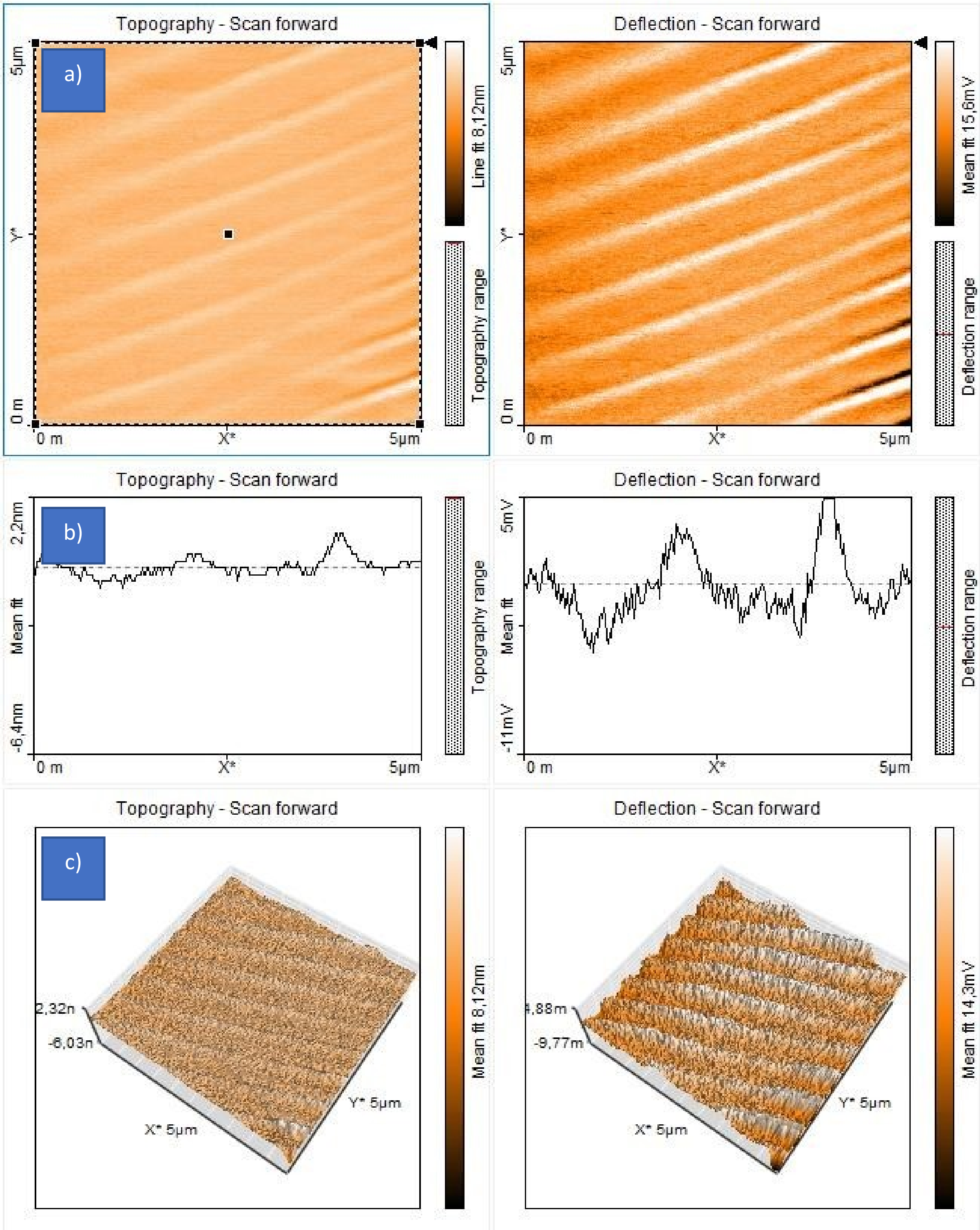

Figure 4: AFM a) 2D, b) line and c) 3-D topography and deflection images of SbO-G.

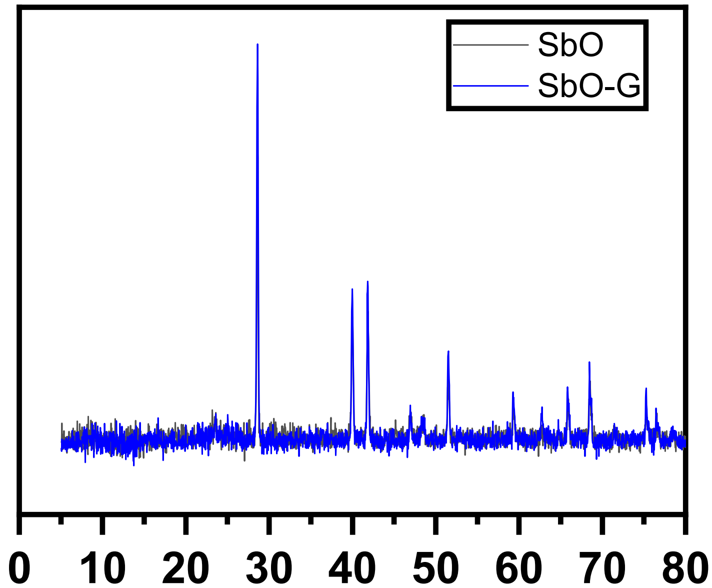

Figure 5: XRD pattern of SbO overlayed on SbO-G

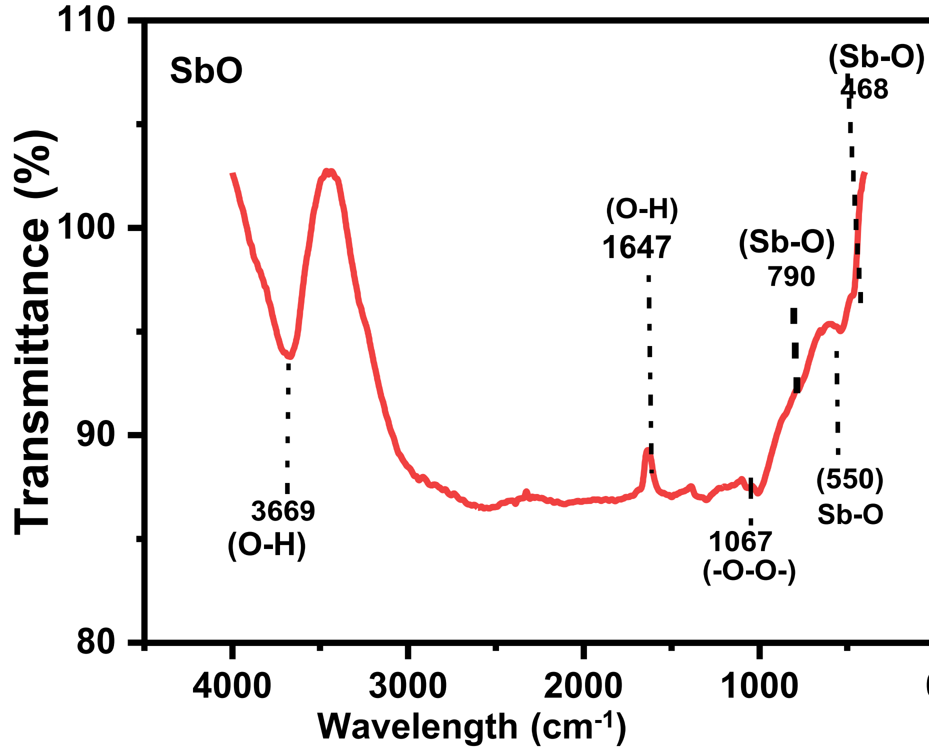

Figure 6: FTIR spectrum of SbO.

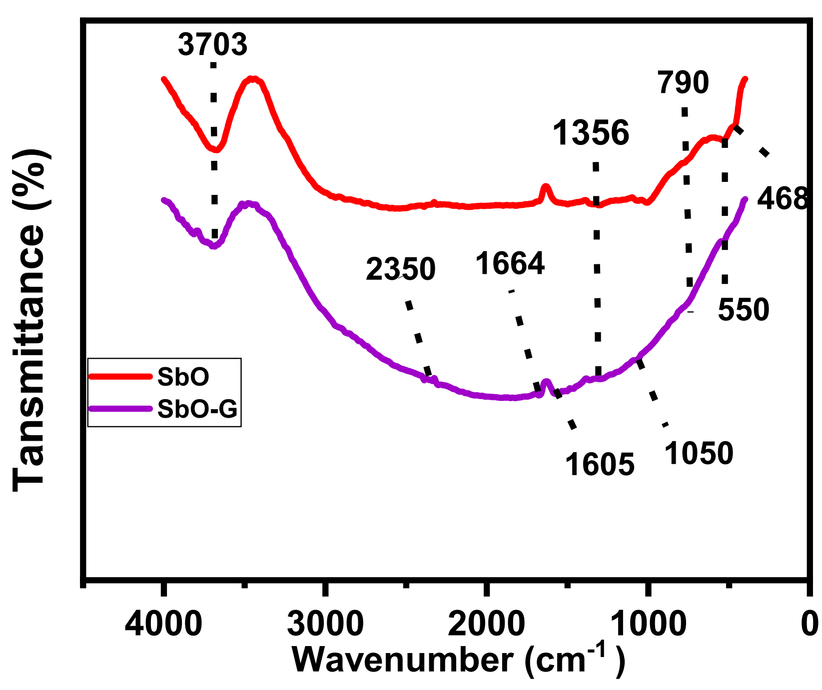

Figure 7: FTIR spectrum of SbO and SbO-G

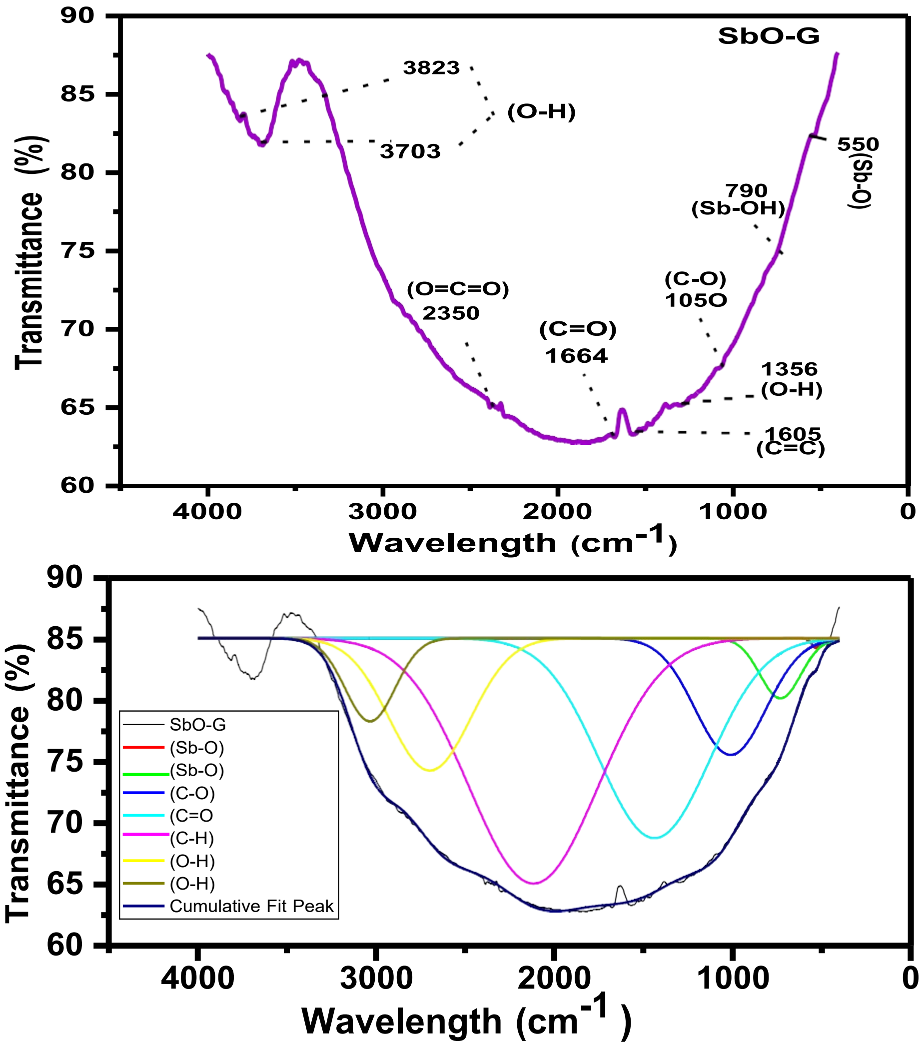

Figure 8: FTIR spectra of SbO-G alone, deconvoluted absorption bands SbO-G showing the presence of both SbO related bands and carbon-based bands.

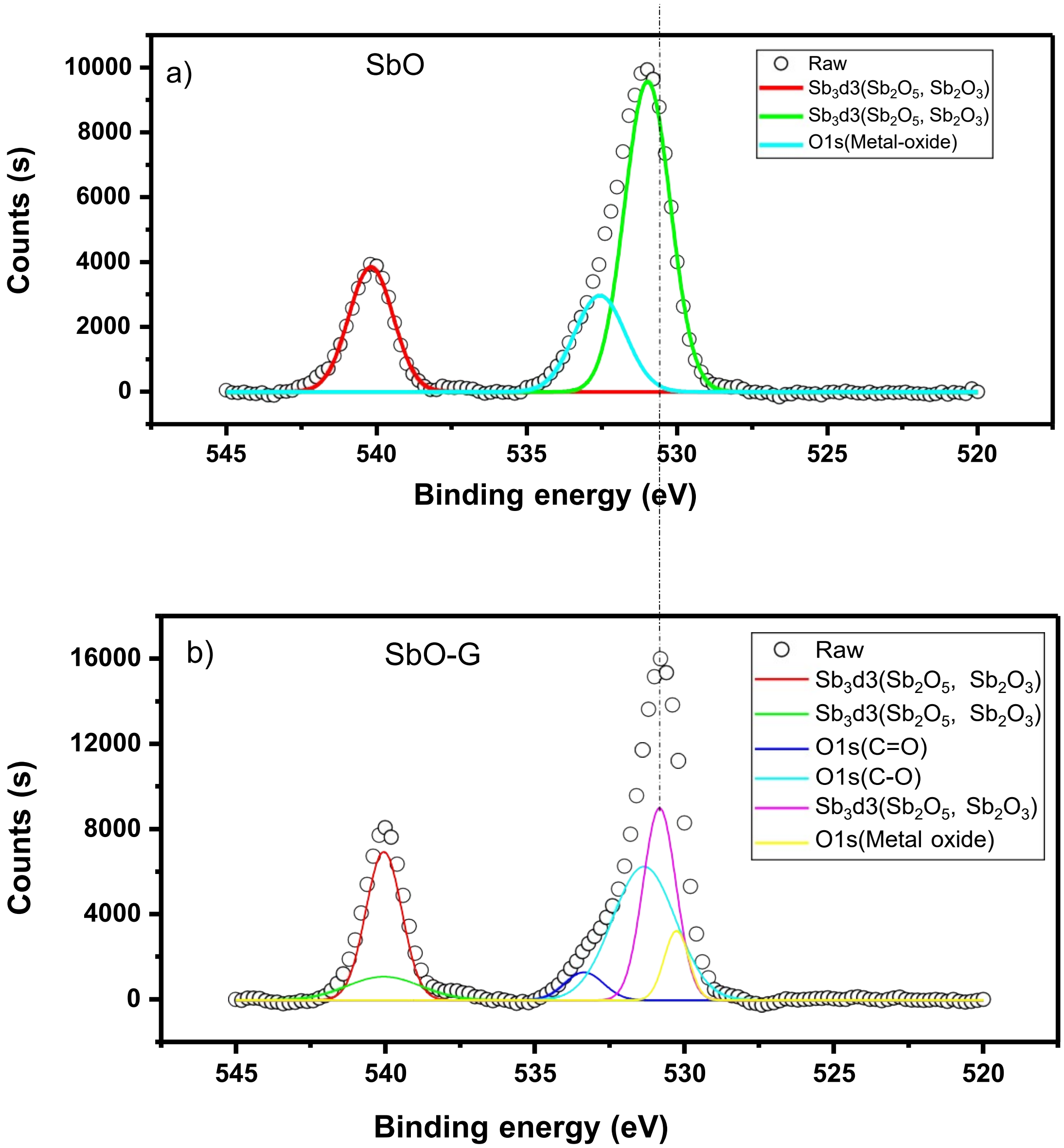

Figure 9: XPS spectrum of SbO and SbO-G showing the Sb_3 d3 position.

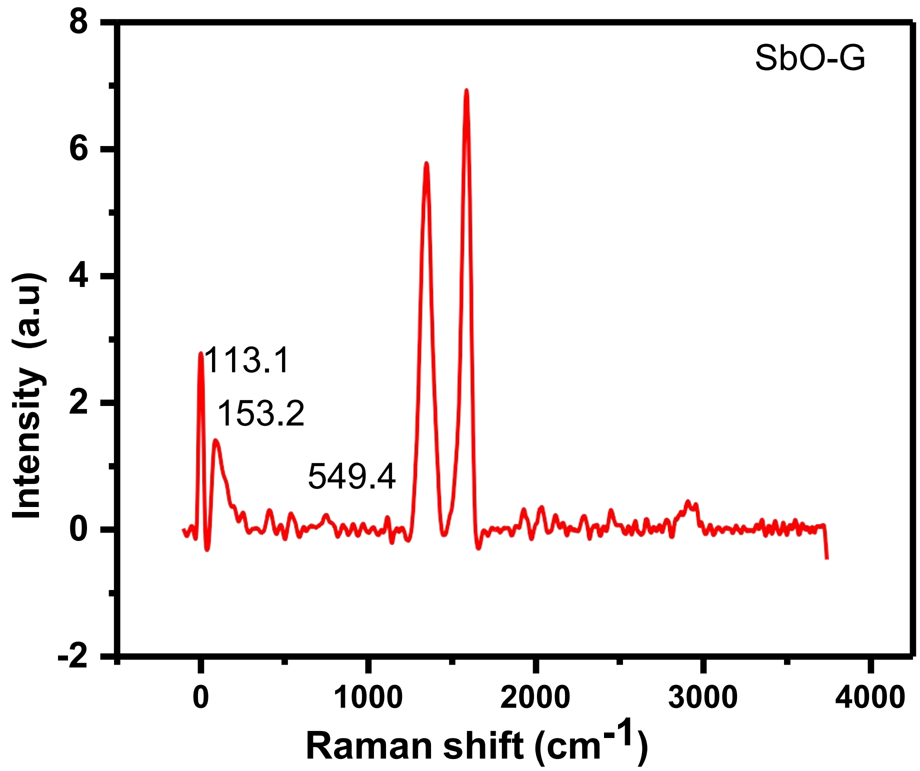

Figure 10: Raman spectrum of SbO-G alone defining the modes clearly.

Photoluminescence spectroscopy

The photoluminescence spectra (PL) were obtained to evaluate the photo-excited electron transport in SbO and SbO-G composites. The PL emission spectra of SbO and SbO-G hybrids are shown in Figure. At room temperature, the dispersed sample in ethanol solution was excited at 210 nm and measured. The PL spectra of SbO has a green-blue spectrum with the highest intensity at 367 nm and SbO-G shows higher intensity than SbO [29]. The results show that the recombination capability rate of electrons, as well as holes, is strengthened considerably in the SbO-G composite [30]. The bandgaps of the samples can be calculated from the PL wavelengths using.

$$Eg = hc\lambda \qquad \text{Eq.-1}$$

where, h is the Planck constant; c is the velocity of light, and λ is the wavelength of the absorption peak [31]. The bandgap for SbO was 3.31 eV while that of SbO-G was 3.30 eV. The reduced bandgap in the composite will facilitate the transfer of charge. Therefore SbO-G is expected to have a better electrochemical performance.

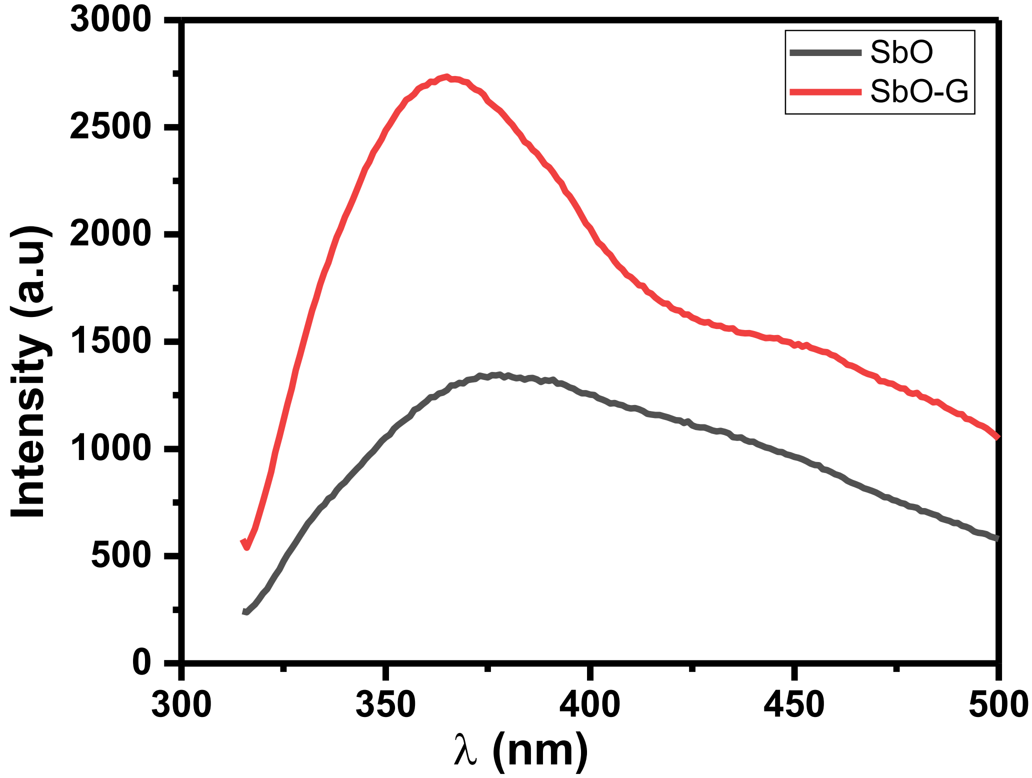

Figure 11: The PL emission spectra of SbO and SbO-G.

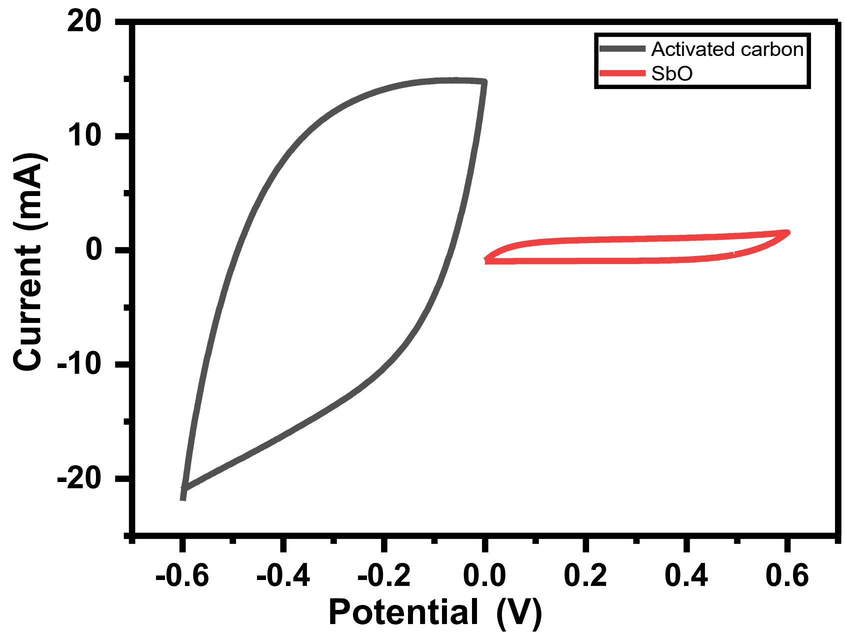

Figure 12: CV plot of SbO and activated carbon in 3 electrodes set up showing the suitability of activated carbon as the negative electrode.