11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Synthesis of SiO_2/C-graphite mesoporous ceramic material and their electrochemical study

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Abstract - SiO_2/Carbon graphite ceramic material with composition in (wt %) SiO_2=50 and 80%, graphite 50% and 20 % respectively were prepared. A SEM image showed that SiO_2 and graphite particles are well dispersed inside the matrix. The specific surface areas for 50% and 20% graphite were S_{BET} = 170 m^2g^{-1} and 157 m^2g^{-1}, respectively. Similarly, the average pore sizes and pore volumes for 50% and 20% graphite materials are 211, 287 Å and 0.90, 1.13 ml g^{-1}, respectively. The resistance obtained for 50% and 20% graphite material were 45 and 2.3 x10^4 Ω respectively.

The ceramic materials obtained by the sol-gel processing method have attracted great interest in obtaining to construct electrochemical devices over the past decades due to their well known facilities of obtaining uniform electrochemical studies and applications [1]. A new technique of electrically conducting ceramic material synthesis has been developed by using sol-gel processing techniques. In this method, carbon is incorporated into the SiO_2 matrix as fine and highly dispersed particles increasing considerably the conductivity of the resulting substrate [2].

The SiO_2/C-Graphite with different composition were prepared by the sol-gel technique according to the following procedure: Tetraethylorthosilicate (TEOS, Aldrich) and ethanol were mixed in 1:1 (v/v) ,after that put 4 mL of water and two drops of HCl into the mixture than reflux and stirred the mixture for three hours at 70 °C. After completion of first step than, put 3.3 gram graphite (Aldrich 99.99 %) to the mixture, followed by addition of 4 ml of H_2O, than keep the mixture in sonicator for 20 minutes, and put 0.6 mL of HF to the mixture. The resulting gel was dried at room temperature for 12 days, grind in a mortar, sieved and washed with ethanol, and finally dry them under vacuum at 125 °C for four hours.

The 50%C-graphite material (Fig 1a) shows a higher conductance as compared to 20% material (Fig. 1b). Similarly the 20% material show larger pore size 1.13 ml g^{-1} and pore volume 287 Å than the 50%material 0.8975 cc/g and 211 Å respectively. Both materials show that graphite particles are distributed uniformly with in SiO_2 matrix.

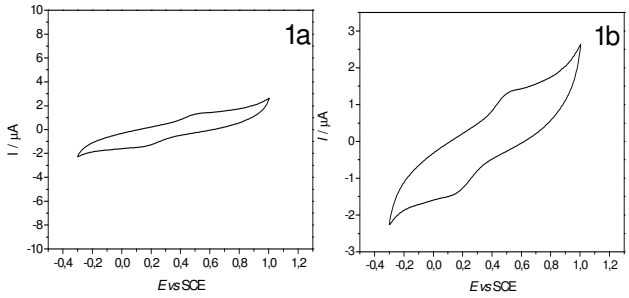

Figure 1: Cyclic voltammograms (1a) 50% graphite (1b) 20 % graphite.

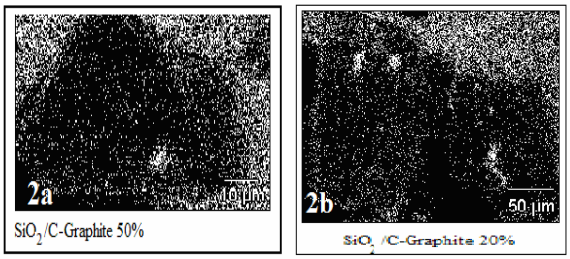

Figure 2: SEM image of SiO_2/C-graphite (2a) 50 % graphite and (2b) 20% graphite.

References

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[2] Y.Gushikem.A.M.S. Lucho, E.Marafon, M.S.P. Francisco, R. Landers, "Preparation process of electrically conducting ceramicSiO2/ZrO2/C-Grphite" Brazilian Patent, INPI,PI 0506395-7(2006).

Acknowledgments. The author gratefully acknowledges the support of this work by TWAS/CNPq for doctoral fellowship. YG is indebted to FAPESP for financial support.