

Fig. 6. Distribution of pore volume of Pt/PANi composite as the function of pore diameter.

The average crystallite size of PANi has been found to be approximately 4.01 nm. The average size of Pt in Pt/PANi composite has been found to be approximately 7.76 nm with the crystallite sizes ranging between 9.54 nm and 6.00 nm at the three different lattice planes. This confirms the nano scale of the Pt/PANi composite. The density of PANi was found to be 1.4894 g cm^{-3} while that of Pt/PANi composite was measured to be 1.8480 g cm^{-3} . Inclusion of platinum has resulted in the increase of density of the sample as expected.

BET surface area of the sample is $17 \text{ m}^2 \text{ g}^{-1}$. The adsorption average pore diameter is 27 nm. The distribution of pore volume as a function of pore size is given in Fig. 6. Large fraction of the pore volume is by microporous (<50 nm) pores of the composite and majority of the pores have diameter less than 100 nm. Gradation in the pore volume also promises the continuous flow of the reactant gases without any pressure build up. PANi matrix also contained large open pores in macro porous range which generally cannot be accounted for by BET study.

Fig. 7 shows the SEM images of PANi (a and b) and Pt/PANi (c and d) each at 500 nm and $3 \mu\text{m}$ scales. Continuous matrix is evident from the 500 nm scale (Fig. 7a and c) and the large surface area and highly porous structure of the polymer material is observed from the $3 \mu\text{m}$ scale images (Fig. 7b and d). The presence of dispersed Pt particles could be better viewed in the back scattered SEM image (Fig. 7d). While the Pt particles in the PANi matrix are dispersed, they show agglomeration at some regions.

The transmission electron micrograph of the Pt/PANi is shown in Fig. 8a and b. Platinum particles within nano scale are observed from Fig. 8a, while the agglomeration could be observed in Fig. 8b. The drifting of PANi under TEM study made it difficult to focus the individual particles of Pt.

EDX spectra of PANi (Fig. 9a) and Pt/PANi (Fig. 9b) also confirmed the presence of Pt in PANi. The weight percentages of the elements in the samples are given as tables in the plots. While the PANi structure is constituted by carbon (C), nitrogen (N) and hydrogen (H), the peaks corresponding to C and N are as expected. EDX is not sensitive to the lighter atom H. But the

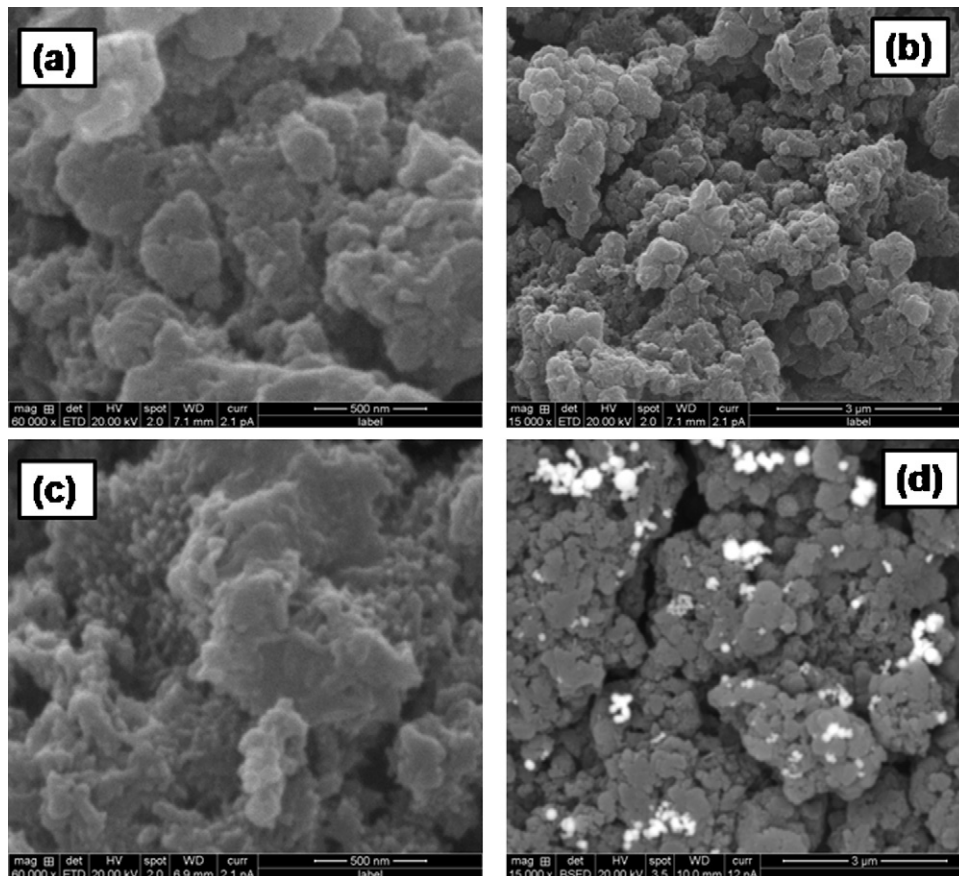


Fig. 7. SEM images of (a) PANi at 500 nm scale, (b) PANi at $3 \mu\text{m}$ scale, (c) Pt/PANi at 500 nm scale, and (d) Pt/PANi (Back scattered image) at $3 \mu\text{m}$ scale.