Development of a CVD-based Technique for Homogeneous Deposition of TiO_2 Nanoparticles inside the Pores of a Porous Carbon Substrate

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TiO_2 is an attractive material for photocatalyst and electrode applications. The utilization of TiO_2 requires the combining of it with a carbon material to improve its electrical conductivity and the nano-sizing of it to increase the surface area contacting with the reactant or electrolyte. The production of such nanocomposites requires expensive initial materials and/or high-costs for processing. Thus, it is difficult to industrially produce such nanocomposites using methods reported so far. In this study, the vacuum liquid pulse chemical vapor deposition (VLP-CVD) technique was developed for the efficient production of porous-carbon/TiO_2 nanocomposites. In this technique, the Ti source vapor can be smoothly distributed into the pores of a porous carbon material before it thermally decomposes and forms TiO_2. By using this technique, TiO_2 nanoparticles with a small diameter were homogeneously deposited in meso- or macro-porous carbon substrates. Such a homogeneous deposition could not be achieved using conventional continuous-flow CVD techniques. Electrode evaluations were conducted to confirm that the small diameters of the TiO_2 nanoparticles and the homogeneous conductive paths within the composites could be efficiently utilized. The results showed that the obtained TiO_2/porous-carbon nanocomposites show excellent performances even at high rates and are very durable. Therefore, the obtained TiO_2/porous-carbon nanocomposites are promising materials for the anode of lithium-ion capacitors.