Morphological and physicochemical properties of the *Burkholderia cepacia* lipase non-covalently immobilized on multi-walled carbon nanotubes

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The commercial lipase obtained from *Burkholderia cepacia* was non-covalently immobilized on multi-walled carbon nanotubes (MWCNT-COOH and MWNCT-OH). The immobilization condition for the carbon nanotubes were defined using immobilization time (0 to 30 min) and relationship of adsorvent:adsorbate (1:4, 1:7 and 1:10) with lipase loading of 100, 175 and 250 mg, respectively. According to the results, it is possible to observe that the MWCNT-COOH and MWCNT-OH presented an effective lipase adsorption. Fast adsorption in about five minutes was observed. Immobilized preparations, free lipase and the support (MWCNT-COOH and MWCNT-OH) were characterized, with thermal analysis [thermogravimetric (TG) and differential scanning calorimetry (DSC)], scanning electron microscopy (SEM) and porosiometric studies (BET methods).The SEM micrographs showed the same microstructure of granular appearance before and after immobilization process. TG results of immobilized lipase confirm the presence of enzyme in both supported materials. For TG, an insignificant weigh loss was observed for raw MWCNT-COOH and raw MWCNT-OH and the most pronounced weight loss was observed to immobilize lipase in both supports in a proportion of 1:10 corresponding to the increased lipase loading. DSC curve of lipase from *Burkholderia cepacia* shows only a well resolved endothermic peak at 112 ^{o}C. Hence, the interesting point is to be noted that the decomposition temperature of MWCNT-OH-lipase and MWNCT-COOH-lipase 1:4, 1:7 and 1:10 were lower. This difference of thermal transition of MWCNT-OH to MWCNT-OH-lipase is probably due to the immobilization of enzyme in which the enzyme is fixed inside the pores of support, and thereby this is the driving force for exchange the thermal stability of immobilized lipase. BET measurement confirms that the both supports had almost the same specific surface area, indicating that specific surface area of the MWCNTs is not influenced by functional groups. However, the decrease in the surface area and pore volume after immobilization indicated the adherence of the lipase from *Burkholderia cepacia* on the MWCNTs cavities.