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Polyurethane/multiwalled carbon nanotube (MWNT) composite membrane characterized by AFM Techniques.

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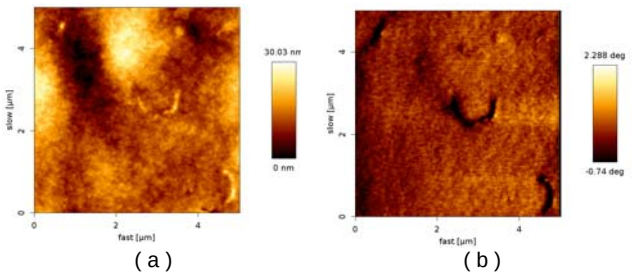
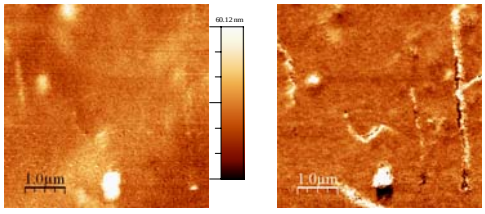
Abstract – Polyurethane (PU) / multi-walled carbon nanotube (MWNT) composite membrane was produced by solvent evaporation method. PU/MWNT solution was prepared by a dispersion MWNT/tetrahydrofurane (THF) and solving commercial polyurethane pellets. The composite membrane was characterized by Digital Pulsed Force Mode (DPFM) and Electric Force Microscopy (EFM). Qualitative images analysis of composite membrane was performed in order to identify MWNT on composite membrane surface. It was possible to observe contrast in DPFM and EFM images at composite membrane characterizing the stiffness and electric field gradient distribution on the sample surface.

Our group has been researching polyurethane membrane to apply in membrane separation process [1]. Polyurethane (PU) / multi-walled carbon nanotube (MWNT) composite membrane has been prepared aiming to improve the membrane separation efficiency. This way, it is important to characterize the MWNT dispersion on sample surface . The AFM techniques as Digital Pulse Force Mode (DPFM) and Electric Force Microscopy (EFM) are powerful tools to analyze the topographic surface. DPFM images allows to map the local stiffness, adhesion, viscosity and many others mechanical properties in parallel with sample topography [2]. Electric Force Microscopy (EFM) is a secondary imaging mode derived from tapping mode that measures electric field gradient distribution above the sample surface [3]. PU/MWNT composite membrane surface was prepared by solvent evaporation method. MWNT was dispersed in tetrahydrofurane (THF) solvent using ultrasonic device for 15 min. Commercial polyurethane pellets (10% w/w) solution was prepared with MWNT(1% w/w)/ THF solvent. SEM (Scanning Electron Microscopy) images and Raman spectroscopy spectra were obtained in order to evaluate MWNT dispersion in THF and to analyze MWNT dispersion in polyurethane membrane. AFM topography and EFM images were acquired using tapping mode (JPK Instrument). The topographic image of PU/MWNT (Fig 1a) shows nanotubes on the sample surface. EFM images of PU/MWNT composite membrane (Fig.1b) allowed to differentiate the MWNT conductive region (dark image region) from PU insulate region (bright image region) on the surface. Comparing stiffness image obtained from DPFM (Witec Instrument) of PU/MWNT composite membrane and topographic image (Witec) it was possible to verify the nanotubes are present not only on the surface but also just below it (Fig 2 and b).



(a) (b)

Figure 1: (a) Topographic image of PU/MWNT composite membrane and (b) EFM image.



(a) (b)

Figure 2: (a) Topographic image of PU/MWNT composite membrane and (b) DPFM stiffness map.

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