Deposition of carbon nanomaterials using waste polymer materials

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Carbon nanowalls (CNWs) are promising materials for various applications. Standard techniques are usually based on classical chemical vapor deposition (CVD) or plasma-enhanced chemical vapour deposition (PECVD) using gaseous precursors. However, these techniques often require a long deposition time of order of minutes or even hours what represents a serious drawback for mass applications. We are presenting an alternative deposition technique where the CNW growth rate of approximately 200 nm/s was obtained. The CNWs were synthesized on plasma-heated titanium substrates using various polymer materials as precursors. The synthesis was performed in a low-pressure inductively-coupled radiofrequency plasma reactor at the power of 500 W. Spontaneous growth of carbon nanomaterials was observed for a variety of polymer precursors. However, their morphology significantly depended on the type of the polymer material, because of different degradation mechanisms of polymers upon plasma treatment and different surface kinetics. The best quality of carbon nanowalls was obtained using aliphatic polyolefins (Figure 1), whereas aromatic polymers were not suitable, indicating that aromatic rings are not the most useful building blocks for CNW growth.

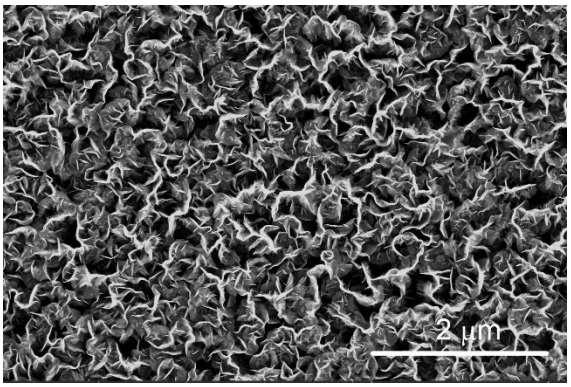

Figure 1: SEM image of CNWs deposited on titanium substrate using polypropylene as a carbon precursor and oxygen plasma.