Improvement of CNT dispersion and of electromechanical properties of polyurethanes nanocomposites by grafting CNTs

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1. INTRODUCTION

Electroactive devices are developed for energy conversion purposes. In particular, polyurethanes (PU) are lightweight and flexible materials which have demonstrated their ability to convert electrical energy into mechanical energy and vice versa [1]. In addition, it has recently been shown that the harvested energy can be increased by incorporating carbon nanotubes (CNTs) into a PU matrix [2, 3]. However, the nanocomposites may not have been optimized, since it is well known that CNTs are hardly dispersed in a polymeric matrix, and that the interfacial adhesion strength is generally poor [4, 5]. One solution to improve both dispersion and adhesion may consist in grafting polymer chains onto the CNT surfaces [6,7].

2. RESULTATS

Here we report a comprehensive study of the role of CNTs and their grafting onto the actuation properties of PU. The effect of the grafting process onto the CNT dispersion state is quantified from electron tomography through the measurement of the local CNT fraction, the CNT tortuosity, the CNT-CNT distance and the number of contacts. Then, a model taking account the experimental microstructural parameter is used for the evaluation of the role of CNTs. The results, compared to experimental data, evidence the minor role of carbon nanotubes.

Control of dispersion of CNT

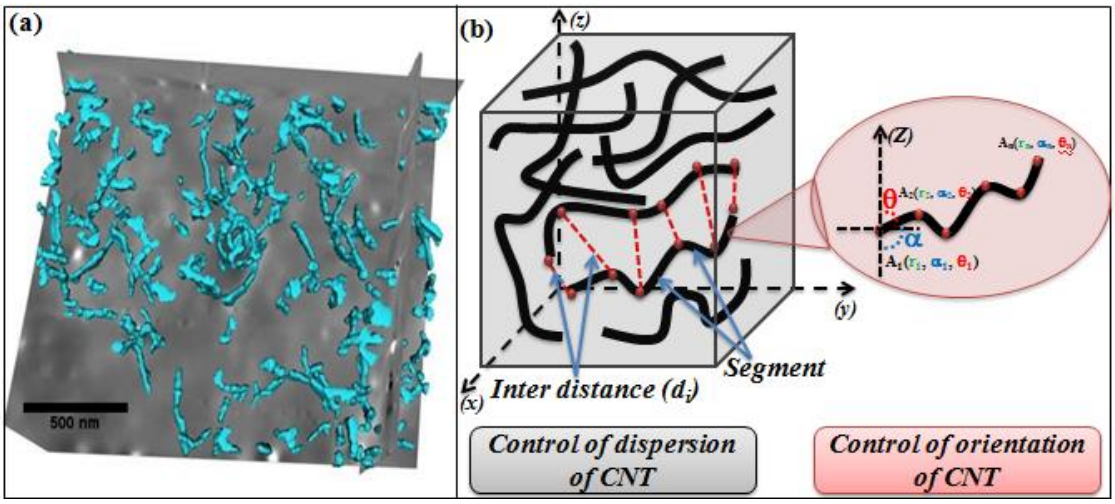

Figure 1. Control of dispersion of CNT: (a) Three dimensional model of the reconstructed volumes were in blue are showed the grafted CNT. (b) quantification of the CNT dispersion and orientation states by segmenting the CNTs into straight lines.

Control of orientation of CNT

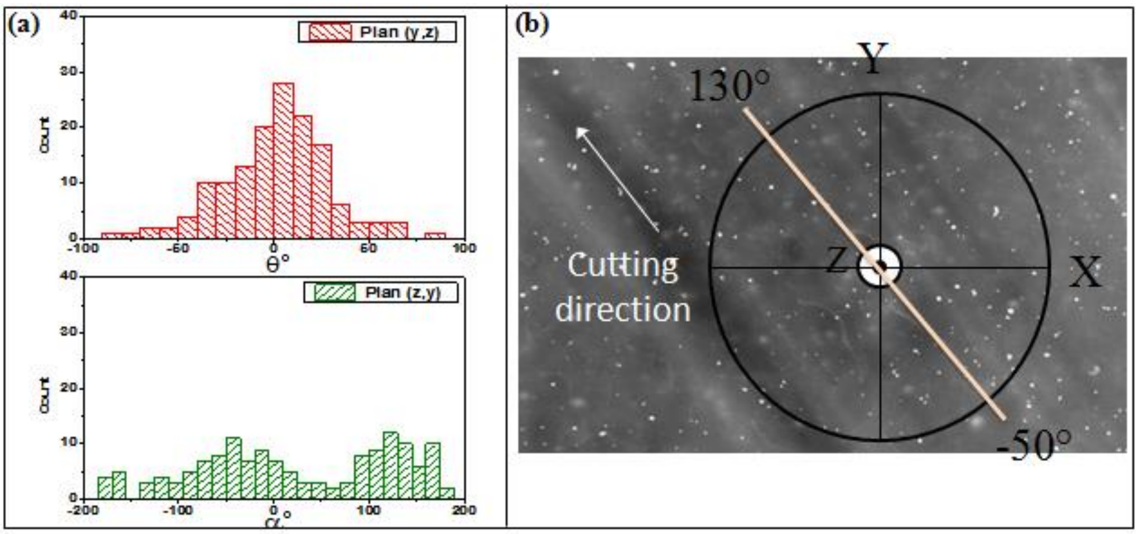

Figure 2. Control of orientation of CNT: (a) Polar angle θ represents the orientation of each segment in the YZ plane and the azimuthal angle α is the orientation of each segment in the XY plane. (b) Orientation and casting direction of CNT in the grafted samples.

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