**Investigation of nanocarbon-based polypropylene composite films and the role of β nucleating agents in their water vapor permeability performance**

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**ABSTRACT**

Polymer nanocomposites have attracted significant scientific attention due to their unique properties, which can be tuned by controlling the type or/and the concentration of the nanoinclusions. Several nanomaterials exhibit exceptional and/or unique properties, e.g. strength and stiffness, attributed to their high surface area, electrical and/or thermal conductivity providing a continuous pathway through the host material. The aim of nanocomposite polymers is to significantly enhance the properties of the bulk material without significant weight gain; the same applies for the polymer films area.

Polymeric films enabling water vapor permeability can be designed either by using micro/nano-fillers, which interrupt the continuity of the polymer phase generating micro/nano-porous structures, or/and by creating micro/nano-pores into the composite material by uniaxial/biaxial stretching. Among the nano-fillers that can be used, CNTs are considered to be highly water vapor permeable materials and have been proposed as nano-porous fillers in membranes for molecular separation1. The potential of using nano-carbon-based polymer composites, as water vapor permeable films2, is obvious.

The main goal of this study is to develop breathable nano-carbon based (MWCNTs or/and GO species, chemically modified with functional groups) polypropylene (PP) composite films, in order to improve performance/cost ratio against the bench mark films made from stretched PP/CaCO3 composites. PP was selected since it is a widely used commodity thermoplastic due to its easy processability and low price, combined with its good chemical & physical properties. PP exhibits several crystalline phases, namely the α-, β-, and γ-phases; the type of the crystalline structure-phase upon processability has an important effect on final properties, as in water vapor permeability. In this context, in the present work, we additionally introduce, as a second filler, a β- phase developer (β-nucelating agent, β-NA). The role of β-ΝΑ is to create porosity that will allow enhanced water vapor permeability3. By controlling the β-NA/filler mass ratio, 4 an optimum content of the β-crystalline phase is anticipated to be maintained, allowing the water vapor permeability of the nano-carbon polymer films to be enhanced.

**KEYWORDS:** Nanocomposites, Polypropylene, Carbon based nanomaterials, β nucleating agent, Water vapor permeability

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