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Silicon oxide permeation barrier coating of PET bottles and foils using a biased microwave plasma

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There is a growing demand for bottles made of polyethylene terephthalate (PET) on the global market. However, PET offers poor barrier properties against gas permeation and the shelf live of packaged food is reduced. A permeation barrier coating of PET bottles and foils is developed by means of a microwave driven low pressure plasma reactor based on a modified Plasmaline antenna. Barrier performance is enhanced by depositing a transparent plasma polymerized silicon oxide (SiO_x) coating on the inner surface of the PET bottle [1]. Up to now SiO_x-barrier coatings on foils and hollow bodies are deposited and characterised without control of the ion energy. The influence of ion energy on the characteristics of plasma and coating is investigated using a substrate bias to generate variable ion energy distributions.
Barrier properties are determined concerning oxygen and carbon dioxide permeation. The composition of the coatings regarding carbon and hydrogen content is analyzed by means of Fourier transform infrared spectroscopy (FTIR). A strong relation between barrier properties and film composition is found: good oxygen barriers are observed as carbon content is reduced and films become quartz like. Atomic oxygen etching of the coated substrate visualizes coating defects responsible for a residual permeation [2]. Absolut calibrated optical emission spectroscopy and Langmuir probe measurements yield in plasma parameter, such as electron density (n_e), average electron energy (E_{mean}) and electron energy distribution (EEDF). Ion energy distribution (IEDF) is determined using a plasma monitor and a retarding field analyzer.

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Keywords
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