Investigations of plasma polymerized SiOx barrier films for polymer food packaging

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The permeation of gases (e.g. O₂, CO₂) and vapors (e.g. H₂O, flavors) through polymers represent an important challenge when using them as packaging materials in food or in pharmaceutical industry. State-of-the-art polymer materials for food packaging consist of a multilayer structure of different polymers, as only a combination of several polymers can provide comprehensive barrier properties toward a multitude of gases and vapors. However, such a multilayer polymer is very expensive compared to homo-polymeric packaging materials, particularly with regard to steadily increasing prices in recent years.

The Plasma Enhanced Chemical Vapor Deposition (PECVD) of SiOₓ films is an excellent method to improve barrier properties of commercially available homo-polymeric materials. In addition, it does not affect the recyclability of the homo-polymeric material and is applicable even to heat-sensitive polymers like polypropylene (PP).

The present paper mainly deals with the development and characterization of plasma polymerized SiOₓ barrier films on poly(ethylene terephthalate) (PET) foils and PP food trays. The SiOₓ barrier films were deposited from mixtures of Hexamethyldisilazane (HMDSN) and O₂ by the use of an electron cyclotron resonance (ECR) heated plasma source. The barrier films are characterized by Fourier-transform infra-red absorption spectroscopy and by scanning electron microscopy. The quality of the SiOₓ barrier coatings concerning the oxygen and water vapor permeability was measured as a function of time by the carrier gas method.

A theoretical description of the permeation behaviour of the PET foil as well as of the barrier layers is given by Fick’s 1. and 2. law. We will describe the mechanisms of permeation through the uncoated and coated PET foils by the use of the finite element program Femlab, and we will discuss the main properties of the different barrier layers.

**Keywords**
- barrier
- food packaging
- permeation
- microwave discharge
- silicon oxide