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**multilayer coating of flexible substrates in a roll-to-roll process**

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For the deposition of high barrier coatings on flexible substrates in a roll-to-roll process it is necessary that the barrier effect is maintained even under high strain. However, some research projects show that highly cross-linked barrier coatings are likely to fail under such conditions, which leads to a complete loss of the barrier effect. It is well known that the mechanical and physical properties of the deposited films highly depend on the films morphology. Investigations have been carried out, showing that multilayer structures improve flexibility of high performance barrier coatings. The correlation between film morphology and the behaviour of the permeation barriers under strain is not yet sufficiently described.

The objective of the research work is to characterise the effects of different multilayer structures on the properties of plasma-polymerised coatings, particularly regarding to the behaviour under strain. Investigations will be carried out using a pulsed microwave (2.45 GHz) downstream plasma source in a roll-to-roll process, which allows the coating of foils up to a width of 1 meter. The material used is a PET foil (100 µm thick) Hostaphan RN by Mitsubishi Polyester Film, Wiesbaden, Germany.

As layer forming monomers silicon compounds and hydrocarbon-containing gases are used to deposit multilayer stacks formed by dense, hard silicon oxide (SiO\(_x\)) barrier layers and softer interlayers, mainly formed by silicon or hydrocarbon compounds. The effects of different intermediate layers on the O\(_2\)-permeation properties and strain behaviour are investigated using suitable chemical and physical analysis methods like atomic force microscopy (AFM), in-situ tensile testing in a laser scanning microscope (LSM) and cross-section images obtained by transmission electron microscopy (TEM).

**Keywords**

SiO\(_x\)-based multilayer system
PECVD
roll-to-roll process
flexible barrier coating
in-situ LSM tensile test