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Adhesive-free bonding of web-like plastic-metal combinations at low temperatures

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Innovative materials often form the basis of modern industrial products in all areas of life. One example are special films, such as films for food packaging, flexible circuit boards, decorative and protective films, whose markets are constantly growing. These materials must meet a wide range of requirements, such as permeation to oxygen and water vapor, optical transparency, temperature stability, easy processability. Laminated films are particularly suitable for such complex functions because the different layers of which they are made of combine different material properties. These composites are often made of plastics and metals and are currently being joined using various adhesives. In addition to the high quantities of adhesives, long-term stability, creep tendency and migration are often problematic.

In this paper, a new adhesive-free low-temperature bonding process is presented as an interesting alternative for joining plastic and metal foils. Thin coatings were applied on the polymer and metal surfaces using an Atmospheric-pressure Plasma enhanced CVD process (AP-PECVD). 3-Aminopropyltrimethoxysilane (APTMS) forms a nm-thick adhesive layer, which covalently bonds to the activated webs. Besides polyethylene and aluminium, on which the focus was placed, the adhesion between polyvinylchloride and aluminium was also investigated. In a subsequent step the materials were bonded using a thermocompression bonder at moderate pressure (1,85 N/mm²) and low temperature (< 100°C). Best results were achieved for the bonding of polyethylene with aluminium with adhesives forces up to 2.2 N/mm. By an optimal adjustment of the parameters, such as pre-treatment time, precursor concentration, plasma power and layer thickness, it was possible to generate composites with a high long-term stability. The deposited layers and composites were examined in a basic and application-specific manner by FTIR spectroscopy, contact angle measurements and peel tests on fresh and aged samples.

Keywords

adhesive-free
bonding technology
metal-polymer-compounds
surface treatment
thin film coating