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Atmospheric plasma modification of polymer materials

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There is an increasing industrial demand for controlling the surface properties of materials in a more flexible and environmentally friendly way. Recent developments in the field of atmospheric plasma technology are creating new perspectives for in-line surface functionalisation and coating of materials. Especially low-temperature dielectric barrier discharges (DBD) have attracted a lot of attention. This technology is closely related to corona treatment which is a widely accepted technology in industry, especially for treatment of polymeric web materials. By controlling the gas atmosphere and electrical conditions, DBD technology can increase the efficiency and stability of the surface treatment. Furthermore, by adding reactive chemical precursors to the plasma discharge, the surface chemistry can be controlled and thin functional coatings can be deposited. In the past, the availability of chemical precursors used in DBD plasma processes was limited to gases and liquids with a high vapor pressure and/or high thermal stability, which considerably limited the possibilities for surface modification and coating. The use of nano-sized aerosols enables to overcome these limitations. It allows to use a broad variety of chemical compounds as coating precursors. This paper describes the possibilities of DBD technology for surface modification of polymer materials. Key industrial drivers for the surface treatment are improved adhesion and wetting properties, elimination of toxic chemical primers, reduced use of organic solvents and replacement of silicones in release liners. Applications on foils, nonwovens, fibres, 3D components and particles will be highlighted. Different DBD systems have been developed for treatment of these various material geometries. The applications range from adhesion improvement of polyethylene fibres for better performance of fiber reinforced composites to deposition of low friction coatings on elastomer components.

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