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R2R plasma printing for the cost and resource efficient production of flexible printed circuits, RFID antennas and biosensors

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A new potentially cost and resource efficient reel-to-reel (R2R) technology, based on patterned atmospheric pressure dielectric barrier discharge (DBD) microplasma treatment, here also referred to as plasma printing, and wet-chemical plating for the production of flexible printed circuits , RFID antennas and biosensors is the Plasma Printing and Packaging Technology »P3T«. This paper focusses on the first two process steps of P3T. The first step is reel-to-reel plasma printing. The set-up used consists of a deeply engraved metal printer roller and a stationary high-voltage (HV) electrode which is encased in an isolating material serving as a dielectric. The metal roller here functions as the counter electrode. During plasma treatment the roller rotates together with the polymer film which is thus pressed against the roller surface by the electrode. As the polymer film passes over the recesses of the roller structures, process gas-filled microcavities are created within which DBD microplasmas are generated. In this way the print image on the roller, for instance a circuit structure, is transferred to the polymer film surface in the form of an area-selective surface functionalization to achieve an adherent area-selective metallization in the subsequent wet chemical process steps. These include seeding using ionogenic palladium solutions and chemically reductive metallization. In this paper the optimization of the gas consumption and the HV electrode system of the R2R plasma printing system is described. For different polymers the surface was investigated by e.g. chemical derivatization methods, fluorescence labeling and measurements of the palladium coverage after seeding in dependence of the plasma process parameters. These results were correlated with plating results and peel strengths of the metal film in order to optimize metallization results.

Keywords
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plastic metallization