Plasma Consult

2.45 GHz Microwave Plasma Source SLAN I-DS

Fig. 1: SLAN I-DS

Rapid surface modification of polyethylene in microwave and r.f.-plasmas: comparative study

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The work described below was performed using a PlasmaConsult SLAN-I-DS microwave plasma source.

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Rapid surface modification of polyethylene in microwave and r.f.-plasmas: comparative study

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Abstract

The surface of polyethylene can be modified by intense oxygen plasmas in less than 200 ms. The investigation of such short treatment times is of interest for industrial applications as well as for fundamental research. The change of surface tension during the first 100 ms of a plasma treatment is a characteristic indicator for the chemical modification of the polymer surface. The correlation between surface tension, plasma parameters and treatment time is of practical interest for the layout of a plasma process and the equipment. Two plasma sources have been used: a r.f.-driven hollow cathode discharge (HCD) module and a microwave sustained slot antenna plasma source (SLAN). For each type of plasma the dependence of the surface tension on the treatment time was determined for various plasma parameters. Contact angle measurements and calculations using the harmonic mean method, were used to measure the dispersive and polar components of the surface tension of the treated samples. To trace the results back to basic plasma parameters, the plasma ion density was measured by a double Langmuir probe. The dispersive part of the surface tension is only weakly affected by the plasma treatment, in contrast to the polar part. Therefore the focus of this study was placed on the polar surface tension. All measurements show a typical exponential $[\sim(1-e^{-a\cdot t})]$ dependence of the polar surface tension on the treatment time t. The increase can be characterised by a rate constant a, describing the first order kinetic of the process. Furthermore, a saturation surface tension can be defined, which is independent on the types of plasma used and of all plasma parameters, whereas the time constant depends strongly on the type of plasma. The highest rate constants were achieved with the HCD module and high r.f. power (up to 1000 W).

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APPLICATION NOTE

SLAN I-DS

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