PLASMA TREATMENT OF POLYOLEFINE POWDER AS A FIRST STEP FOR ITS FUNCTIONALYZATION

Petr Špatenka,[1,2*] Marta Horáková,[1] Jan Hladík,[1] Zdeněk Michalčík [3]

[1]Technical University of Liberec, Department of Material Science, Studentská 2, CZ-416 Liberec, Czech Republic, [2]SurfaceTreat a.s. Na Lukách 669, CZ-51401 Turnov, Czech Republic, [3]University of South Bohemia, Department of Physics, Jeronýmova 10, CZ-37115 České Budějovice, Czech republic

ABSTRACT

Cold plasma surface modification has been established as an effective and low-cost technology for modification of surface properties of polymer materials without altering the bulk material. Modification of plastic packaging foils, plastic headlights, or automobile bumpers prior metallization or painting may be given as examples of industrial applications. On the contrary, only rare information has been issued about plasma treatment of PE powder though powder is a parental material for a lot of application e.g. protective steels coating. Polyethylene copolymers belong also to the family of hot melt adhesives. Polyethylene powder with good adhesion of PE to metal is demanded for these applications. Polar groups on plasma modified PE contributes to formation of chemical bonds between the metal and the polyethylene.

A microwave plasma reactor equipped with a mechanical stirring was used for the experiments. The reactor is described in more detail elsewhere [1]. Oxygen and air were used as the working gas in the most experiments. The working pressure varied between 50 and 200 Pa. The wettability of the PE powder was determined with a tensiometer from dynamic capillarity rising measurements according to the Washburn method [2]. Adhesion of the modified polyethylene molded to a steel substrate was measured using a shredder in a special holder described in Ref. [3]. The ESCA analyses were performed on selected samples.

Plasma modification led to a significant enhancement of the adhesion force. The adhesion strength of the polyethylene-metal joint exceeded several Mp in case of modified powder, whereas the joint between steel and unmodified powder failed and the strength was below the detection limit of 500 Pa. The correlation between the wettability, density of the OH groups and the adhesion force is studied. Cross-linking of the powder surface initiated by the plasma irradiation has been found to be the phenomenon which strongly influences the adhesion of the molded powder to the substrate.

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References:

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