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Primary amine grafting on polystyrene using a non destructive plasma functionalization technique

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In recent years, the use of plasma to functionalize polymers has gained a lot of interest mainly for biological and biomedical applications [1,2]. Among all the typical functional groups (amino, hydroxyl, carboxyl,epoxy..) primary amines (-NH_2) are the most studied because of their well known chemical reactivity. Indeed, they allow covalent coupling of proteins in aqueous environments and this is why they are believed to be efficient in immobilizing biomolecules and in improving cell adhesion [1-3]. Numerous plasma types have been used to reach an efficient primary amine density on polymers surfaces. One of the often mentioned drawbacks of plasma treatment of polymers is the destructive action of the reactive plasma phase towards the polymer due, among other reasons, to ions, electrons and UV bombardment.
In this work, we propose the use of a nitrogen-based µ-wave plasma post-discharge in order to functionalize polystyrene with -NH_2 groups. The plasma is generated in a surface wave sustained discharge operating at 2.45GHz. The use of the post-discharge, where the density of energetic species is very low [4,5], allows to avoid the well known damages on the polymer sample. The plasma treated samples are characterized using X-Ray photoemission spectroscopy (XPS) while the post-discharge chemistry is evaluated by mass spectrometry measurements.
We report on the effects of different experimental parameters (flow, pressure, gas composition...) on the -NH_2 density and selectivity showing that an optimum can be determined. Then we propose, based on these data, a chemical mechanism (chemical etching of the grafted primary amine) explaining why hydrogen radicals concentration has to be chosen with precaution. Finally, we demonstrate the importance of the post-treatment in order to obtain the highest level of primary amine o the PS surface.
[1] A.A.Meyer-Plath et al. Vacuum71(2003) /[2] Special Issue.PlasmaProcessPolym 3(2006) /[3] K.Kchröder et al.Contrib.PlasmaPhys41(2001) /[4] T.Godfroid et al. Surf.Coat.Tech1276(2003) /[5] B.Ruelle et al.J.Mater.Chem17(2007)

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