A COMPARITIVE STUDY OF COPOLYMERIZATION BY R.F. INDUCTIVELY COUPLED PLASMA

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In order to gain an insight into the process of co-monomer pulse r.f. inductively coupled plasma, the plasma gas phase was investigated by the optical emission spectroscopy and mass spectroscopy for the different reactive compositions. Styrene monomer, accompanied by anther monomers (MMA, HEMA, tetraglyme, and diglyme) with similar chemical structure was applied to plasma copolymerization. Both spectra observed in gas phase would correlated and provide successive steps of organic plasma-chemical conversion into stable polymer. Optical emission spectroscopy was carried out in order to identify the species and investigate the variation of specie density in plasma. The neutral species in gas phase were monitored by mass spectroscopy.

All experiments were performed at pressure 20Pa, at discharge power 120W and at duty cycle 50%. Under the same plasma condition, two kinds of variation were considered. Firstly, in the styrene and MMA case, Plasma gas phase was studied as a function of the monomer fraction. Then, we replaced MMA by another monomer in plasma, but only in equal relative fraction (half of styrene and half of anther monomer). In optical emission spectra the species observed are very similar, as the same main products are shown: C, C_2, CH, H and H_2, CO, O_2. These species come from the different reaction plasma: fragmentation, recombination, dehydrogenization etc.. The excited states of different species excited appear very different characteristics because of the different chemical structures of reactive monomers and the different fraction of compounds.

For monomers with same functional group, the number of oxygen and hydrogen gives very important influence for the species in plasma. It is evident that the continuum of hydrogen molecule around 300nm varies as a function of the number of O and H atom in monomer. A comparison of the mass spectra recorded before and after discharge ignition revealed a strong fragmentation of the monomer molecule. The peak intensity corresponding to monomers was drastically reduced, while the signals of low molecular weight compounds become high. In brief, the kind of bond (single bond or double bond) and the number of O and H atom in monomer determine the excited state and the intensity of species.

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