Structural Characteristics of Plasma Polymerized Hydrocarbons

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The structural features of polymer oils (M.W. 500) prepared by polymerization of ethylene (PPE), ethylene/acetylene (PPEA), butadiene (PPBD), and benzene (PPB) were determined through the combined use of infrared and NMR spectroscopy and pyrolysis mass spectrometry. The polymer samples were prepared in an fr (13.56 MHz) discharge sustained between two parallel plate electrodes. All of the materials were found to contain methyl, methylene, trans unsaturated, vinyl, and mono-substituted aromatic groups. The relative concentrations of these groups $\left(\frac{\text{mole chemical group}}{\text{g polymer}}\right)$ were determined from infrared data, and varied significantly depending on the monomer used. NMR data supported infrared results and confirmed the presence of aromatic protons in all of the polymers. Structural formulae for the plasma polymerited oils were deduced which, although strictly appropriate only for conceptual purposes, successfully explain the IR, NMR, and mass spectral data and are consistent with the H/C ratios obtained by elemental analysis.

The concentration of each characteristic group present in the oil obtained by plasma polymerization of ethylene was determined from the IR spectrum of the oil, using published extinction coefficients. Similar characterizations were made of film and powder products which could also be obtained from ethylene. A discussion will be presented of the structural differences between these three products. The variations in polymer structure obtained as a function of preparation conditions will also be discussed.

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