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Plasma Polymerization at Low- and Atmospheric-Pressure – A Comparison Based on Energy Conversion

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In the plasma polymerization literature, there has been an interest since at least the 1970s to correlate the structure of plasma polymer deposits with plasma parameters during deposition, most particularly with the energy input per monomer molecule, E_m (or somewhat equivalent, E_a) in low- (LP) and atmospheric-pressure (AP) discharge plasmas. In this work we propose a new parameter, the so-called energy conversion efficiency, ECE, which permits direct comparison of LP and AP experiments. This is done for the case of three model compounds, ethane, acetylene, and acrylic acid. 'Critical' energy values that demarcate ECE regimes separating different fragmentation/reaction mechanisms agree remarkably well for all three monomers examined; resulting in E_m (or E_a) values are correlated with specific mechanisms, and the numerical results are convincingly supported by data from the chemical literature. Thus, the measurement of the energy conversion in LP and AP plasmas helps to control plasma polymerization processes.

Keywords
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control of gas phase processes