Air effect on both polymerization kinetics and thermal degradation properties of novel HCN polymers based on diaminomaleonitrile

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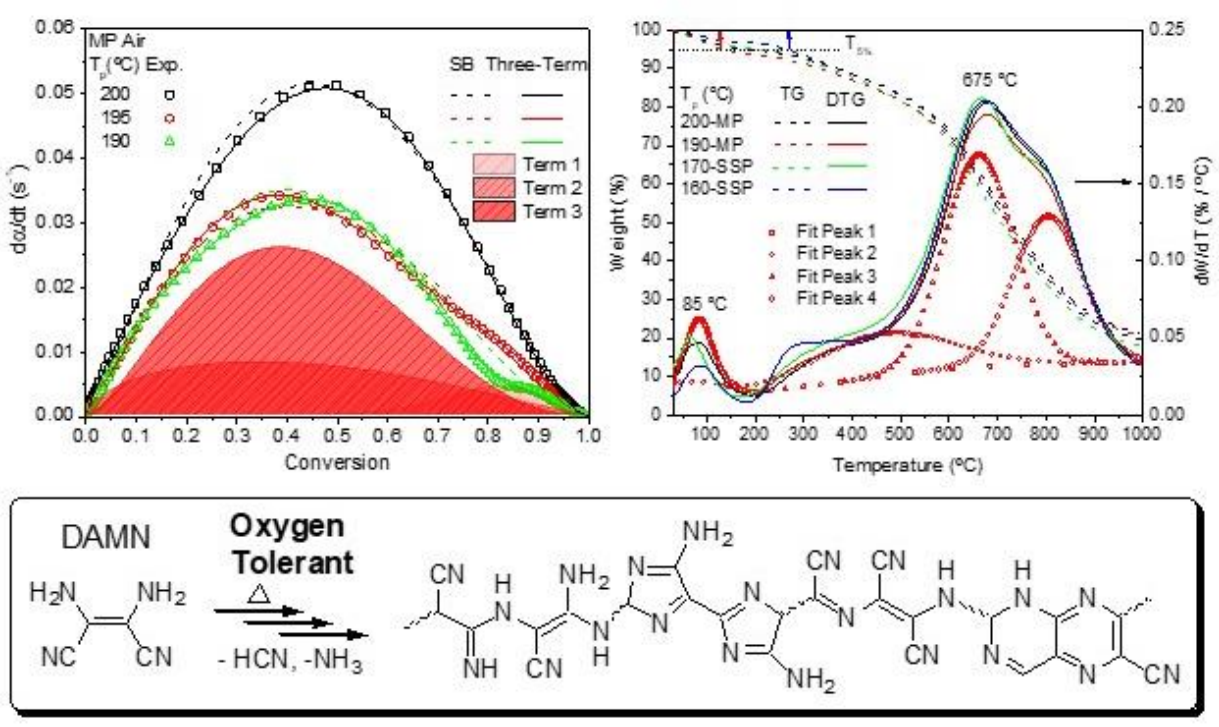

The impact of air on the bulk polymerization kinetics of diaminomaleonitrile (DAMN), tetramer of HCN, and thermal degradation properties of this resulting conjugated C=N polymeric system is investigated under different temperature regimes and environments. This study shows the effect of exposure to air and oxygen, time, temperature, and evolved gases during DAMN polymerization reactions, which can be suitably monitored by differential scanning calorimetry (DSC) through both dynamic and isothermal measurements. Thus, low heating rates and isothermal scans at 150-170 ◦C allow us to describe the solid-state polymerization (SSP) of DAMN, and those experiments at 190, 195 and 200 ºC and higher heating runs define its melt polymerization (MP) behaviour. Both processes are highly efficient, possibly due to the self-acceleration nature of their kinetics, which is consistent with a three step Šesták-Berggren (SB) model. The oxygen effect was analysed to determine their tolerance to this variable and confirm the non radical nature of the mechanism under study. In addition, a detailed thermal characterization by simultaneous DSC/thermogravimetry coupled to mass spectrometry (TG-MS) of these singular polymeric systems obtained under air atmosphere has been completed, and the improvement of the thermal stability of those samples prepared by an SSP at lower temperature was confirmed. The present work offers lower cost and simpler synthetic methods to obtain this novel class of promising multifunctional polymeric materials through highly efficient and very fast processes.

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