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IN SITU OBSERVATION OF THE FOAMING PROCESSES UNDER EXTENSIONAL STRESS

C. B. Park* and A. Wong

MPML (Microcellular Plastics Manufacturing Laboratory), Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, Ontario, Canada M5S 3G8

park@mie.utoronto.ca

The cell morphology of plastic foams is determined by the nucleation, growth, and collapse of the cells during the foaming process. Clear understanding of the thermodynamics, kinetics, and rheological behaviors in these phenomena is imperative for developing high-quality foams with customizable cell morphology for specific applications. Despite extensive pioneering works to elucidate such behaviors, further investigation is needed to clarify the underlying mechanisms of the foaming process. This paper presents our research in this area, which consists of two branches: 1. Numerical modeling of simultaneous cell nucleation and growth; 2. Experimental investigation to observe plastic foaming processes in situ with visualization systems. Using the empirical data generated in the latter study, the underlying theories of the numerical models could be verified and improved. Our previous foaming visualization studies of PS-talc composites demonstrated that the expansion of nucleated cells triggered the formation of new cells around them despite the lower gas concentrations in these regions. This is believed to be caused by local tensile stresses that are induced around the talc particles near growing cells. To further investigate this phenomenon, the foaming processes of PS-talc samples blown with CO_2 were observed with a foaming visualization system with extensional strain-inducing ability. The stress-induced foaming results could be extended to explain the nucleation behaviors in polymers with other dispersed phases.