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Robert Simha, a pioneer in polymer physics, and Emeritus Professor of Macromolecular Science & Engineering at Case Western Reserve University, passed away peacefully on 5 June 2008 at his residence in Cleveland Heights, Ohio.

Robert Simha

Simha was born in Vienna, Austria, in 1912, entered the Institute of Physics of the University of Vienna in 1930, and graduated with the PhD degree in 1935. His thesis advisors were Hans Thirring and Felix Ehrenhaft. His thesis topic, "Contribution to Colloid Hydrodynamics", was influenced by discussions with Eugene Guth, a theoretical physicist working with a dynamic interdisciplinary group, directed by Herman Mark, studying the properties of polymers. Simha was set the challenge of extending Einstein's viscosity theory of rigid spheres to higher concentrations and to ellipsoidal and flexible solutes. Thus began an influential line of enquiry, with publications extending until 1981, and involving collaborations with S. G. Weisberg, Jacques L. Zakin, and Leszek Utracki, whose achievements were recognized by the award of the Bingham Medal of the Society of Rheology in 1983.

In 1938, Simha went to a postdoctoral fellowship at Columbia University sponsored by Victor K. La Mer. There, ground-breaking research was initiated with Elliott Montroll on a kinetic theory of chain degradation processes. In 1942, Simha obtained a faculty position at Howard University and began a third seminal research direction with Herman Branson on the kinetics and statistics of copolymerization chain reactions. Next came a move to the National Bureau of Standards in 1945, and a theory of depolymerization with Leo Wall, experimentally confirmed by Sam Madorsky, accounting for a spectrum of behaviors varying from random scission to unzipping with high monomer recovery. After this, he went to New York University's Department of Chemical Engineering, where a longstanding interest in the statistical thermodynamics of the liquid state was put into practice, deriving with a student, Stuart Hadden, the equations of state of linear and branched paraffins, using the cell theory of Ilya Prigogine. This work became the starting point for major explorations of the configurational thermodynamics of macro and small molecules. During this time also, in collaboration with Harry Frisch, and Fritz Eirich, a theory of adsorption of long chains from solution was developed.

In 1958, Robert moved to the University of Southern California. Collaboration with Ray Boyer, on the equilibrium and non-equilibrium properties of polymer melts and glasses, resulted in widely-used correlations between glass transition temperature, T_g , and the thermal expansivity at T_g . However, the most significant development was the derivation of the cell-hole theory of chain molecule liquids with Thomas Somcynsky. The theory correctly describes the temperature and pressure effects on specific volume (PVT), as well as on the lattice vacancy fraction, *i.e.*, the free volume content.

In 1968 Robert Simha joined Case Western Reserve University. Collaboration with Alexander Silberberg and a student, Robert H. Lacombe, focused on the kinetics of cooperative processes in macromolecular structures, synthetic or biological. Anh Quach constructed a pressure dilatometer, performed careful PVT measurements on two polymers, in melt and glass, demonstrating for the first time quantitative agreement with the cell-hole theory. The results stimulated international research, extending the success to over 50 polymers and their mixtures. Simha had notable collaborations with Raj K. Jain (India) extending the hole-cell theory to multicomponent systems, with Eric Nies and Alex Stroeks (The Netherlands) to phase equilibria, with Hankun Xie (China) and Chul B. Park (Canada) to gas solubility, with Leszek A. Utracki to extrusion-foaming of polymers, and the molecular dynamics of molten and glassy polymeric nanocomposites.

An approach to non-equilibrium properties through the use of the computed hole fraction was developed. With John McKinney, the partial freeze-in of free volume at T_g was demonstrated, with Leszek A. Utracki the relationship between the hole fraction and viscous flow was investigated, and with John G. Curro and Richard E. Robertson, the kinetics of volume relaxation explored. Connections between hole fraction and positronium annihilation lifetime spectroscopy were studied with John McGervey, Alex M. Jamieson, Gianni Consolati and Franz H. Maurer. A theory of elastic constants of polymer glasses with Elisabeth Papazoglou, involved the stress dependence of free volume.

Up to the last day of his life Robert Simha was a productive and original scientist, and a cherished member of the polymer physics community, enlivening scientific discussions and social events with his wry sense of humor and superb knowledge of classical music. His

achievements were recognized by the award of the Polymer Physics Prize of the American Physical Society in 1981.

A. M. Jamieson, I Otterness and L. A. Utracki