A Universal Representation of the Critical Thermal-Conductivity Enhancement in Molecular Fluids

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The thermal conductivity of fluids exhibits a pronounced increase in a large range of temperatures and densities around the critical point. Mode-coupling theory of non-asymptotic critical dynamics yields an equation relating the critical thermal-conductivity enhancement to equilibrium thermodynamic properties, the correlation length, and the viscosity. We have reviewed experimental data for the critical thermal-conductivity enhancement of about two dozen fluids and show they can all be represented by a universal equation containing only one fluid-dependent parameter, which corresponds to a cutoff wave length for the critical fluctuations. Moreover, for classical molecular fluids both the correlation length amplitude and the cutoff wave length correlates with the cube root of the critical volume as a characteristic length. Hence, it has now become possible to estimate the magnitude of the critical thermal-conductivity enhancement in molecular fluids, even in the absence of experimental thermal-conductivity data in the critical region.