ABSTRACT

STUDIES OF STATIC AND DYNAMIC CRITICAL BEHAVIOR OF SIMPLE BINARY FLUIDS AND POLYMER MIXTURES USING X-RAY PHOTON CORRELATION SPECTROSCOPY

by

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X-Ray Photon Correlation Spectroscopy (XPCS) and its applicability to studies of critical dynamics of binary systems is the subject of this thesis. XPCS is an extension of visible light Photon Correlation Spectroscopy (PCS) into the region inaccessible to visible light. XPCS is a unique technique for studying low frequency dynamics at short length scales.

This thesis reports on XPCS studies conducted with samples exhibiting fast relaxation dynamics and having relatively low scattering rates. In particular the critical dynamics of the binary fluid mixture Hexane/Nitrobenzene was studied. The effects of synchrotron radiation x-ray damage on the polymer mixture Polystyrene/Polybutadiene was extensively studied, in order to determine the stability of the polymer samples in x-rays. Some general rules for determining the sample lifetime upon exposure to x-ray have been derived. Preliminary measurements of the critical dynamics of the binary polymer mixture Polystyrene/Polybutadiene are also reported. Some future modifications to the experimental setup have been outlined that would allow for an improvement in data quality. Measurements of the static critical behavior of the Polystyrene/Polybutadiene polymer mixtures revealed a crossover from mean field to Ising behavior at a reduced temperature that was found to be consistent with the Ginzburg criterion.