

Abstract (English)

This thesis presents a study and analysis of the material properties and phase behavior of liquid-in-liquid systems. Both pure liquids and solutions containing solutes such as drug, salt, oil, protein and antibody have been investigated. Chapter 2 presents a thorough description of the micropipette manipulation technique used as the primary experimental method throughout this thesis. Chapter 3 presents the theory associated with liquid microdroplet dissolution and some of the considerations that have been taken into account when applying the Epstein-Plesset model. Diffusion coefficients of octanol-in-water, $D = 7.2 \pm 0.5 \times 10^{-6} \text{ cm}^2/\text{s}$, water-in-octanol, $D = 1.96 \pm 0.1 \times 10^{-6} \text{ cm}^2/\text{s}$, water-in-decane, $D = 3.3 \pm 0.2 \times 10^{-5} \text{ cm}^2/\text{s}$, DCM-in-water, $D = 2.0 \pm 0.2 \times 10^{-5} \text{ cm}^2/\text{s}$ and Ibp-in-water, $D = 5.2 \pm 0.7 \times 10^{-6} \text{ cm}^2/\text{s}$, are presented. Chapter 4 focuses on NaCl as a solute and presents a novel triple micropipette technique for supersaturation, $10.3 \pm 0.3 \text{ M}$, and saturation, $5.5 \pm 0.1 \text{ M}$ measurements. It is shown that the extended Epstein-Plesset model successfully predicts diffusion controlled microdroplet growth and that induction time and surrounding medium affects crystal morphology. Chapter 5 presents Triolein parameters in an ethanol-water-lipid system. Solubility, 31 mg/ml in ethanol, diffusion coefficient, $D = 3.7 \pm 0.3 \times 10^{-6} \text{ cm}^2/\text{s}$ in ethanol, and interfacial tension, 31 mN/m vs water and 1 mN/m vs ethanol are presented. Effect on interfacial tension of POPC addition was measured, 1.7 mN/m vs water, and parameters were used to predict the critical nucleation sizes for 'trapped' Triolein nanoparticles, 20 nm. Chapter 6 presents micropipette investigations of protein, sugar and antibody systems as part of a commercial scale-up for protein and antibody microglassification formulation. Final concentrations of bovine serum albumin, $1143 \pm 82 \text{ mg/ml}$, and bovine gamma globulin, $1388 \pm 177 \text{ mg/ml}$, in the microglassified particles were measured. Bulk preparation of bovine gamma globulin were made and scanning electron microscopy was used to compare the different microparticles.