Phase Diagram Visualization via Continuously-Fed Crystallization

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Abstract:
A continuously-fed crystallization chamber is manufactured to allow phase diagram visualization. This microfluidic system allows the experimenter to screen a large range of salt and protein concentrations in one experiment. This allows the experimenter to predict the phase diagram of a protein in a single experiment. A continuous-feed crystallization chamber has been successfully fabricated and characterized in terms of its flow profile. This device has successfully predicted the phase diagram for lysozyme.

Tetragonal Lysozyme:
The flow and species transport through the PDV is modeled using Fluent. Experimental results as well as model results are used to construct the phase diagram. For tetragonal lysozyme with sodium chloride at a pH of 4.5, the phase diagram is already known.n. The input streams coming into the PDV were as follow: protein-hen egg white lysozyme at 0.75 mg/mL (0.05 M sodium acetate, pH 4.5) and salt-sodium chloride 150 mmol/L (0.05 M sodium acetate, pH 4.5). The feed rate for all three inlets was constant at flow rates of 0.5, 1.16, and 5 µL/hr. All simulations and experiments were run for 24 hours.

The flow and species transport through the PDV is modeled using Fluent. Experimental results as well as model results are used to estimate the location of the phase diagram. The phase diagram for tetragonal lysozyme is already known. The input streams coming into the PDV are: protein-hen egg white lysozyme at 30 mg/mL (0.05 M sodium acetate, pH 4.5) and salt-sodium chloride 150 mmol/L (0.05 M sodium acetate, pH 4.5). The feed rate for all three inlets is constant at a flow rate of 3 µL/hr.

Triclinic Lysozyme:
The flow and species transport through the PDV is modeled using Fluent. Experimental results as well as model results are used to estimate the location of the phase diagram. The phase diagram for triclinic lysozyme has not been reported. Triclinic lysozyme requires a heat cycle to grow; the PDV is started at 0°C for 8 hours then moved to room temperature for the remainder of the 16 hours. The input streams coming into the PDV are: protein-hen egg white lysozyme at 30 mg/mL (0.05 M sodium acetate, pH 4.5) and salt-sodium chloride 150 mmol/L (0.05 M sodium acetate, pH 4.5). The feed rate for all three inlets is constant at a flow rate of 3 µL/hr.

Buoyancy Driven Convection

Dye Experiments

Buffer (B) = 0.05 M Sodium Acetate (SA) pH 4.5
Protein (P) = 75 mg/mL, 0.05 M SA pH 4.5
Salt (S) = 155 mg/mL NaCl, 0.05 M SA pH 4.5
FR = 100_500_100 µL/hr

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References: