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# 种子乳液聚合中复合乳胶粒结构形态的热力学分析

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摘要 为了得到一种能够预测和控制乳胶粒结构形成的定量方法，本研究选用含有两 种聚合物乳胶粒(P_a和P_b)和水的体系作为模型体系来模拟种子乳液聚合体系，在 不考虑动力学因素的条件下，对乳胶粒可能出现的三种极限形态进行了热力学分析 。结果表明，最终乳胶粒稳定的结构形态不仅取决于体系中的P_a，P_b和水三者之 间的界面张力γ_(aw)，γ_(bw)和γ_(ab)，而且还取决于两聚合物的体积分数 V_a和V_b。形成P_a/P_b型正核壳结构乳胶粒的热力学必要条件是(γ_(aw)-γ_(bw))/γ_(ab) > V_a~(2/3)-V_b~(2/3)和(γ_(aw)-γ_(ab))/γ_(bw) > (1- V_b~(2/3))/V_a~(2/3)；形成P_a/P_b型反核壳结构乳胶粒的热力学必要条件是(γ _(aw)-γ_(bw))/γ_(ab) < V_a~(2/3)-V_b~(2/3)和(γ_(bw)-γ_(ab))/γ_(aw) > (1-V_a~(2/3))/V_b~(2/3)。对以聚丙烯酸酯为种子有机硅氧烷的乳液聚合体系的初步研究结果表明，所得乳胶粒的结构形态与利用上述热力学关系式预测的结果 基本一致。

关键词 乳液聚合 乳胶 热力学分析 聚丙烯酸酯 硅氧烷

分类号 0631.3

## Thermodynamic Analysis of Composite Latex Particle Morphologies in Seeded Emulsion Polymerization

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**Abstract** In order to get a quantitative method to predict and control the composite latex particle morphologies in seeded emulsion polymerization, a model system consisting of two polymer particles (P_a and P_b) and continuous phase of water was used to simulate the seeded emulsion polymerization system, and a thermodynamic analysis was conducted for three possible extreme morphologies of composite latex particles under the condition where kinetic factors were not considered. The results showed that the final stable latex particle morphology was controlled not only by interfacial tensions (γ_(aw), γ _(bw) and γ_(ab)) between three phases (polymer A, polymer B and water) , but also by the fraction volumes (V_a and V_b) of the two polymers. The thermodynamic requisites for the formation of P_a/P_b core/shell latex particle were (γ_(aw)-γ_(bw))/γ_(ab) > V_a~(2/3)-V_b~(2/3) and (γ_(aw)-γ_(ab))/γ_(bw) > (1-V_b~(2/3))/V_a~(2/3); and those for the formation of P_a/P_b core/shell latex particle were (γ_(aw)-γ_ (bw))/γ_(ab) < V_a~(2/3)-V_b~(2/3) and (γ_(bw)-γ_(ab))/γ_(aw) > (1- V_a~(2/3))/V_b~(2/3). When acrylate-silicone seeded emulsion polymerization system was used to test these relationships, preliminary experiment investigated that the particle morphology is basically agreement with the prediction results of thermodynamic analysis.

**Key words** EMULSION POLYMERIZATION LATEX THERMODYNAMIC ANALYSIS POLYACRYLATE SILOXANE

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