Experimental report

31/10/2017

Proposal: 9-12-478 **Council:** 4/2016

Title: Surfactant-induced charging of polydimethylsiloxane-poly(methyl methacrylate) latexes in nonpolar solvents

Research area: Chemistry

This proposal is a new proposal

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Samples: n-dodecane (h and d) solvent backgrounds
PDMS-PMMA dispersions in n-dodecane
deuterated AOT solutions

Instrument	Requested days	Allocated days	From	To
D33	1	1	16/11/2016	17/11/2016
D22	1	0		

Abstract:

Sterically-stabilized poly(methyl methacrylate) (PMMA) latexes charged by Aerosol OT (AOT) in nonpolar solvents are a well-characterized model system to understand the nature of charge in low dielectric fluids. Despite being well-studied, the latexes have typically only been produced using one steric stabilizer, poly(12-hydroxystearic acid) (PHSA). Polydimethylsiloxane (PDMS) has emerged as an effective replacement for PHSA, with highly beneficial properties compared to PHSA: it is commercially available and can be reproducibly and controllably synthesized. The native charging behavior of these PDMS-stabilized particles, both in pure solvent and with added AOT, however, is different to PHSA-stabilized particles, which are typically uncharged in low dielectric solvents. Additionally, the magnitude of the particle charge can be modified by the addition of ethylene glycol dimethacrylate (EGDMA) crosslinker. We propose using contrast-variation small-angle neutron scattering (CV-SANS) with appropriate selective deuteration (to the surfactant and polymer) to study the distribution of crosslinker and AOT surfactant within PDMS-stabilized latexes.

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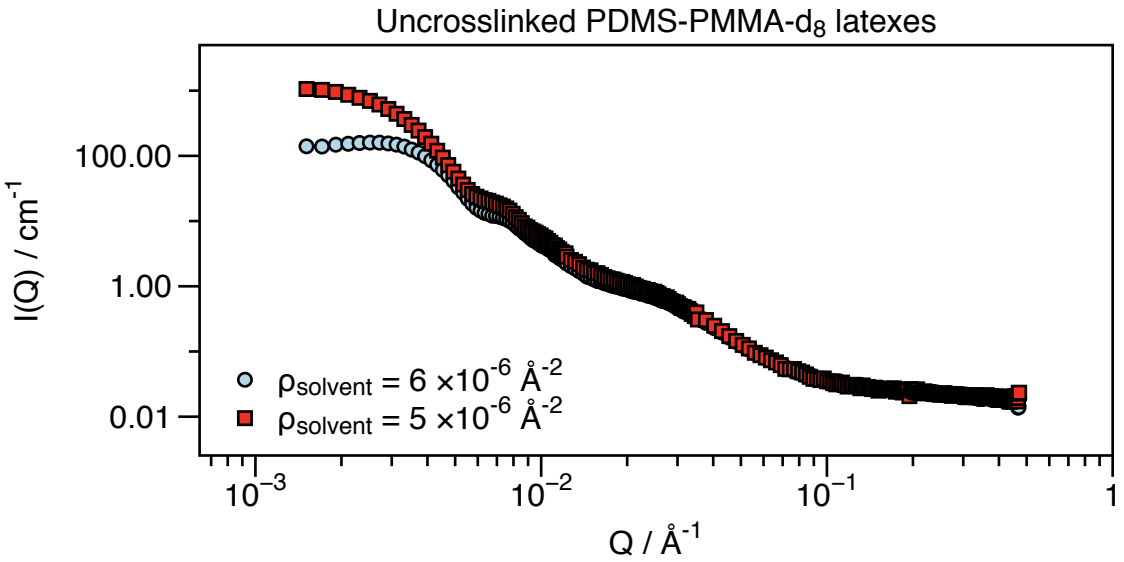
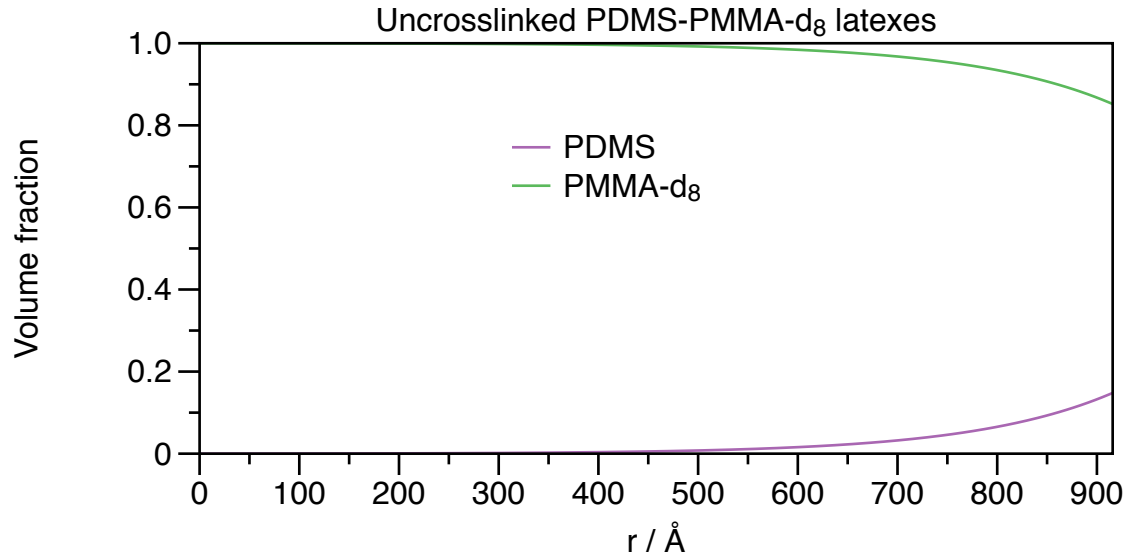
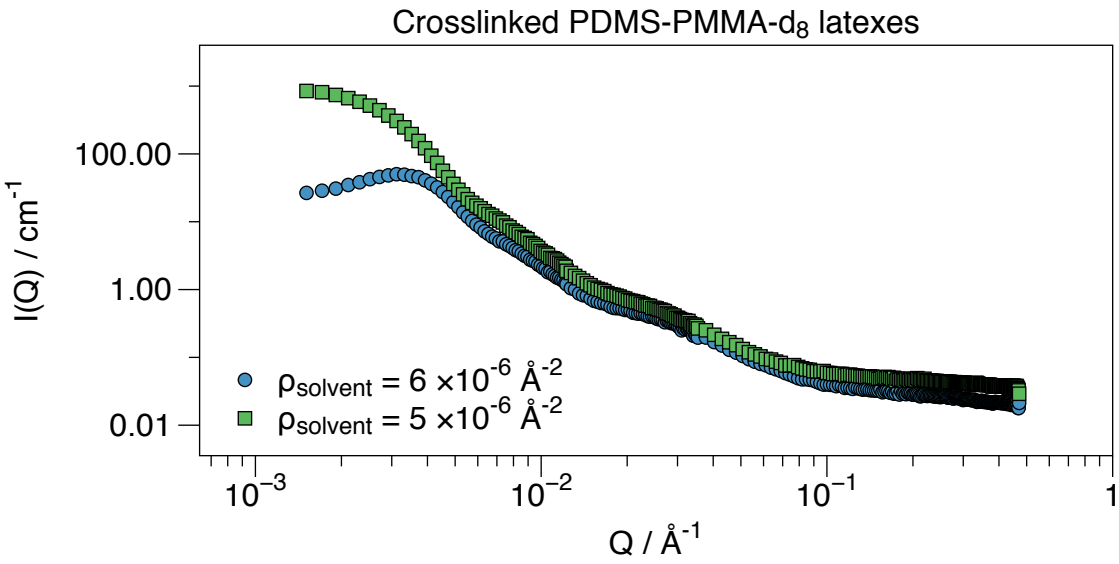
Experiment dates: 16/11/2016–17/11/2016

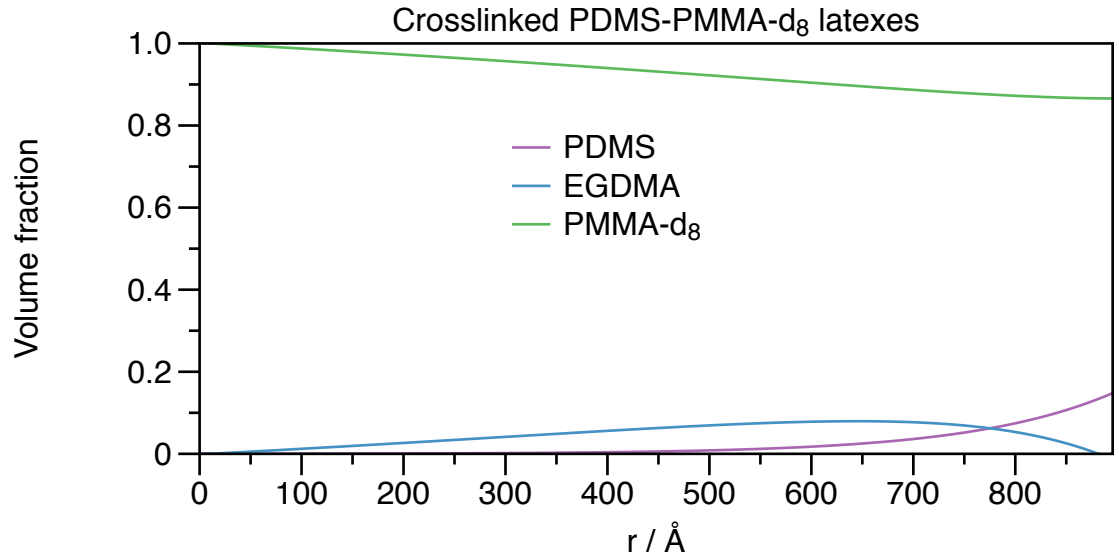
Contrast-variation SANS measurements were used to determine the distribution of a dimethacrylate crosslinker (EGDMA) in poly(dimethylsiloxane)–poly(methyl methacrylate) latexes dispersed in dodecane, a typical nonpolar solvent. The latexes were prepared with a PMMA-d_8 core to give isotopic contrast with the hydrogenous EGDMA crosslinker. The latexes were then dispersed in dodecane solvents with different scattering length densities (either 6 or 5 × 10^{-6} $Å^{-2}$). This enabled the spatial distribution of all the components in the core of the latexes (PMMA-d_8, PDMS, and EGDMA) to be determined through a constrained fitting procedure. Further analysis of the data will make it possible to couple the distribution of components with the properties of the latexes.

SANS data






Crosslinked PDMS-PMMA-d8 latexes
I(Q) / cm-1
100.00
1.00
0.01
ρsolvent = 6 ×10-6 Å-2
ρsolvent = 5 ×10-6 Å-2
10−3
10−2
10−1
1
Q / Å-1


Crosslinked PDMS-PMMA-d8 latexes
Volume fraction
1.0
0.8
0.6
0.4
0.2
0
PDMS
EGDMA
PMMA-d8
0
100
200
300
400
500
600
700
800
r / Å