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Formation of Toroid Micelles: Mechanism and Size Control HONGGANG CUI, KELLY HALES, ZHIBIN LI, DARRIN POCHAN, Department of Materials Science and Engineering, University of Delaware, Newark, DE 19716, ZHIYUN CHEN, KAI QI, KAREN WOOLEY, Department of Chemistry, Washington University in Saint Louis, Saint Louis, MO 63130 — The toroid micelle morphology has been produced by the self assembly of poly(acrylic acid)-block-poly(methyl acrylate)-block-polystyrene triblock copolymer via interaction with organic diamines in mixed THF/H2O solution. The formation mechanism has been investigated from three aspects: (i) chain structure of organic counterions, including spacer length, chain hydrophobicity and the number of amine groups; (ii) molecular structure of triblock copolymer, including block length of polystyrene and chain architecture; (iii) variation of solution component, such as different ratios of THF to water and different ratios of amine groups to acid groups. It was found that toroids can be constructed either via a cylinder-toroid transition through elimination of high-energy, cylinder ends, or via a disc-toroid transition by disc perforation from the center. The prevalent mechanism depends on the chain length of polystyrene and the chain structure of diamines. Stability of the toroids was studied by varying the ratio of THF to water, and by applying a perturbation of either heat or sonication. Interestingly, the size of the toroids can be controlled by the amount of added diamines. The toroid morphology was characterized by means of cryo-TEM, SANS and light scattering.

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