

## Structural Changes and Evolution in Pluronic F127 Solutions with Added Pharmaceuticals

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Aqueous solutions of polyoxyethylene-polyoxypropylene-polyoxyethylene triblock copolymers (Pluronics) undergo micellization and structural arrangement (observed macroscopically as a gelation) as their temperature is raised. The micelles typically arrange into cubic quasicrystalline lattices. The presence of these ordered structures can be controlled through both polymer concentration and temperature. In addition, the presence of dissolved solutes can affect the onset and kinetics of structure formation. This property has made Pluronics a material of interest for drug delivery applications. Previously, we have investigated the effects of added methylparaben (as a model pharmaceutical) on the kinetics of Pluronic F127 gelation using rheology, DSC, and DLS. We found that methylparaben lowers the gelation temperature of these solutions, and observed an increase in the gelation rate. Here we examine directly the structures formed by F127 solutions ranging from 10 to 30% using small-angle x-ray scattering (SAXS) as they have been heated through their phase transitions. We examined both the progressive evolution and collapse of these structures as the temperature is increased from 0°C (below the critical micelle temperature), through the gelation temperature, up to 80°C. Time-resolved SAXS measurements were made in order to elucidate the kinetics of the structure evolution, and how it is affected by the presence of methylparaben. We found that while methylparaben reduces the temperature at which micellization and gelation occur, the evolution of the quasicrystalline structure is a more gradual process as the temperature is raised. Neat solutions of equivalent concentration exhibited a more rapid change from the disordered to the ordered state. Methylparaben also serves to stabilize the micelle lattices, allowing them to persevere at higher temperatures; they also homogenize the structures throughout the solution, as the SAXS scattering rings were more uniform compared to neat solutions that exhibited “speckling,” indicative of localized ordering domains. Finally, we collected some preliminary data involving F127 solutions with added dexamethasone, another pharmaceutical.