Tunable Phosphonic Acid Content of Block Polymer Micelles While Maintaining Constant Core Size

Taylor Larison[1], Morgan Stefik[1]

1.University of South Carolina, Columbia, South Carolina, United States

Polymers with phosphonic acids have the potential for a wide range of applications due to the uniquely strong binding capabilities. However, the use of such strongly binding polymer blocks remain underexplored where possible applications span from surface modification and particle ligation to micelle control of nanoparticle placement, all of which utilize block polymer analogs. For example, many micelle applications rely on both controlled size and tailored functionalization where the independent control over these parameters has been limited. This limitation is in part because the equilibrium micelle size is affected by the extent of functionalization. Here it is shown that these parameters can be decoupled by implementing a glassy core with a unique processing pathway. This process enables chemical modification to the corona of previously formed, kinetically-trapped "persistent" micelles, termed Persistent Micelle Corona Chemistry (PMCC). Here PMCC is shown using RAFT to synthesize an amphiphilic diblock polymer containing (diethoxyphosphoryl)methyl methacrylate (DEPMMA). The phosphorus-based coronas are then chemically modified to tailor the phosphonic acid content while preserving constant micelle core size. Furthermore, we study the micelle-nanoparticle assemblies under the unique condition of strong nanoparticle binding. Additional applications are examined for surface modification and particle ligation taking advantage of the unique binding capabilities of phosphonic acid containing block polymers.

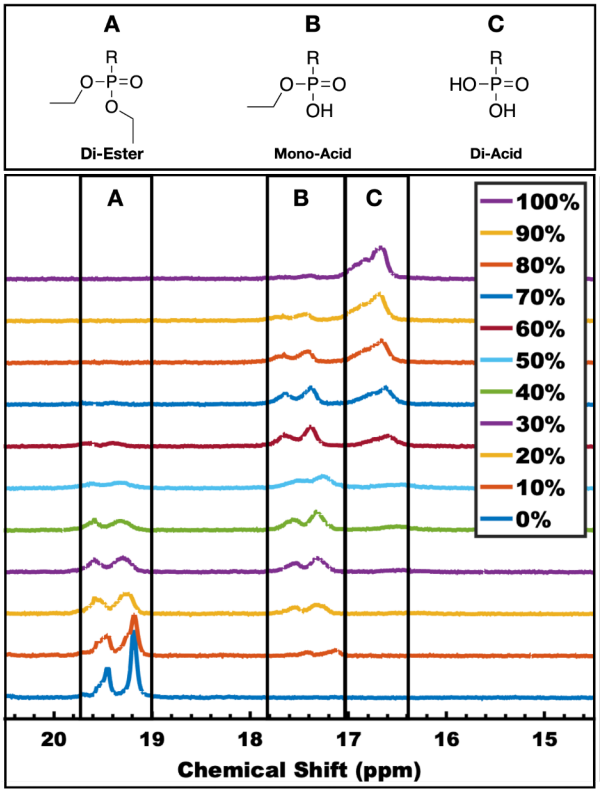

Figure 1. ^{31}P-NMR Showing the systematic control of phosphonic acid formation from a phosphonated ester.

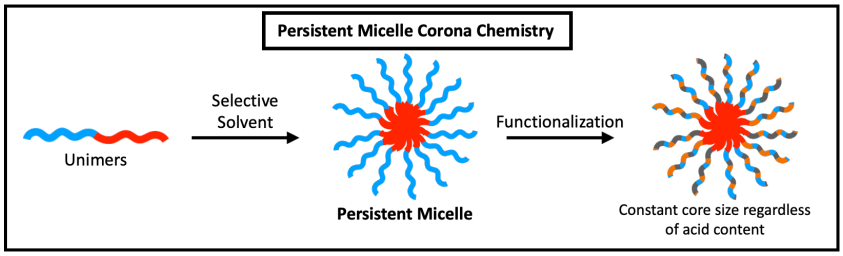

Figure 2. PMCC concept showing the formation of a persistent micelle prior to the functionalization of the micelle corona.