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Hierarchcial structure of solid lipid nanoparticles

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Suspensions of solid lipid nanoparticles (SLNs) stabilized with emulsifiers have been extensively investigated as drug carriers since the 1990s, although details of their ultrastructure are poorly defined. Previously, our group reported a novel microwave-assisted microemulsion-based technique to prepare SLNs. Ultrastructure generally relates to interior of the particle and can relate to internal partitioning through, for example, a core-shell structure. It can also relate to the formulation itself, including the particle itself, but can also include structures such as micelles, which may be simultaneously present.

Our previous investigations revealed that SLNs were prepared by the novel microemulsion technique have size of 200-300 nm. Preliminary multi-angle SLS/DLS studies indicated core-shell type of SLNs. To understand the detailed ultrastructure of these SLNs, ultra-small angle neutron scattering (USANS) and small angle neutron scattering (SANS) experiments were conducted on suspensions of hydrogenated stearic acid SLNs stabilized with hydrogenated Tween 20 surfactant in D2O. Together, SANS and USANS gave a combined Q range of 4.7 × 10^-5 to 6 × 10^-1 Å^−1 (corresponding to a size range of ~ 1 nm - 15 μm). This extended Q range allows a comprehensive understanding of the hierarchical structure of SLNs. The SANS/USANS data are consistent with the multi-length scale structure of SLNs having polydispersed large particles at the microscale level, intermediate between spheres to rod, with roughened surfaces. At the nanoscale level, the results are consistent with the SLNs solution having an ellipsoidal shape intermediate between spheres and rods, with a crossover from mass fractals to surface fractals. The elucidation of this structure is particularly important given that the structure influences the stability and drug release properties of the nanoparticles. These results will assist in the development of systems with desired shape and properties.

Topic

Soft Matter

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