Core-shell polycaprolactone nanoparticles as ultrasound contrast agents  
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Ultrasound contrast agents (UCAs) are core-shell particles that enhance the clarity of ultrasound images by increasing the backscattered ultrasound signal. Most commercial UCAs employ gaseous core materials as the echogenic (ultrasound-scattering) agent. However, this sharply limits UCA lifetime due to rapid diffusion of the gas into the bloodstream. Recent research therefore focuses on developing UCAs with a liquid core encapsulated in a polymer shell.

The core material chosen for this project was perfluorooctyl bromide (PFOB), a non-toxic liquid perfluorocarbon that has a high density and compressibility, and is therefore echogenic.1 Polycaprolactone (PCL) was chosen for the shell material since PCL is biocompatible and biodegradable, and a polymer shell improves stability at high acoustic pressures.2

An oil/water emulsion and solvent evaporation method1 was used to form polymer-encapsulated PFOB nanoparticles. The organic phase, consisting of PCL and PFOB in acetone, was emulsified into sodium cholate solution, and core-shell nanoparticles were formed after acetone evaporation at reduced pressure. An average particle diameter of 200 nm was obtained from dynamic light scattering data, and PFOB encapsulation was confirmed by 19F-NMR analysis.

The echogenicity of the nanoparticle suspension was investigated using a portable ultrasound imaging apparatus. Samples of PFOB-containing nanoparticles and Levovist® (a gaseous UCA) were imaged through a gelatine phantom and the average gray-scale intensities were determined. The average gray-scale intensity of the nanoparticle suspension was found to be significantly higher than that of pure water, demonstrating the echogenicity of the nanoparticles, but was lower than that of Levovist® (Fig. 1.). The change of the sample echogenicity with time was also investigated.

Figure 1. Ultrasound image of PFOB-containing nanoparticles (left), water (centre), and Levovist® (right), and the gray-scale intensity profile corresponding to the boxed region.


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