**Medical & healthcare, Diagnosis, Drug delivery**

# Elastic polymer coated nanoparticles with fast clearance for $^{19}$F MR imaging

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## Abstract

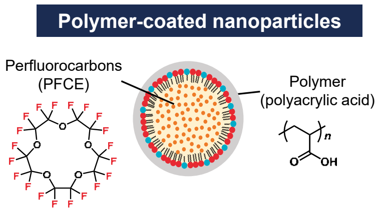
$^{19}$F magnetic resonance imaging (MRI) is a powerful molecular imaging technique that enables high-resolution imaging of deep tissues without background signal interference. In this study, we developed perfluorocarbon-encapsulated polymer nanoparticles as a novel $^{19}$F MRI contrast agent for suppressing long-term liver accumulation. The polymer nanoparticles display high elasticity and exhibit robust sensitivity in $^{19}$F MRI imaging. Importantly, in vivo $^{19}$F MRI data showed a gradual decrease in the signal intensity of the polymer nanoparticles after administration, which contrasts with the behavior observed for stiff silica nanoparticles. These findings indicate that the elastic polymer nanoparticles prevent long-term accumulation in the liver.

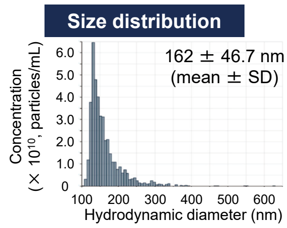
## Background & Results

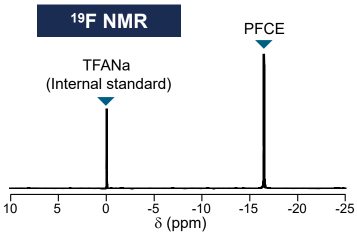
Nanoparticle-based $^{19}$F MRI probes are promising contrast agents for molecular imaging because of the highly sensitive signals. However, stiff silica nanoparticles around 100 nm in size are immediately trapped through mononuclear phagocyte system and accumulated in liver tissue for a long time. Moreover, the impact of elasticity on nanoparticle elimination has remained unclear due to the lack of suitable probes for real-time and long-term monitoring. To address this issue, we developed elastic polymer nanoparticles as a contrast agent for $^{19}$F MRI. The elastic polymer-coated nanoparticles were prepared by formation of nano-emulsion with perfluorocarbons and subsequent templated RAFT polymerization on the surfaces. The resultant nanoparticles have 160 nm in the average size and strong $^{19}$F NMR peak derived from the encapsulated perfluorocarbons. In addition, high-speed atomic force microscopy showed the deformability of polymer-coated nanoparticles upon mechanical stimulation. Furthermore, $^{19}$F MRI signal intensity of the polymer nanoparticles was gradually decreased over 3 weeks after injection, while that of silica nanoparticles remained during the period.

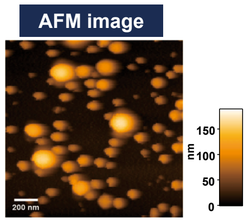
## Significance of the research and Future perspective

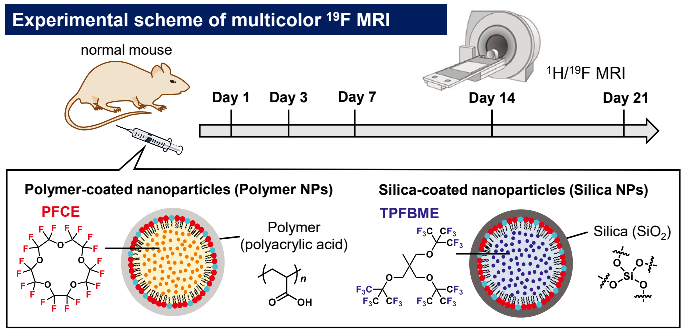
The results demonstrated that the elastic and deformable polymer-coated nanoparticles exhibited a significant reduction in long-term accumulation in the liver after administration into the body. This contrasts markedly with the behavior observed for stiff silica nanoparticles. This polymer-coated nanoparticle system represents a groundbreaking nanomaterial that effectively addresses the challenges associated with long-term accumulation, while enabling tracking of biodistribution over extended periods. In future studies, we aim to tune the elasticity of these nanomaterials and investigate the relationship between nanoparticle transformability, biodistribution, and the underlying mechanisms of nanoparticle elimination. Our findings will contribute to the design of nanoparticles as a probe and a drug carrier for in vivo applications.

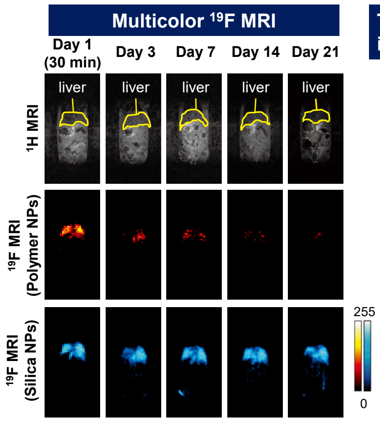


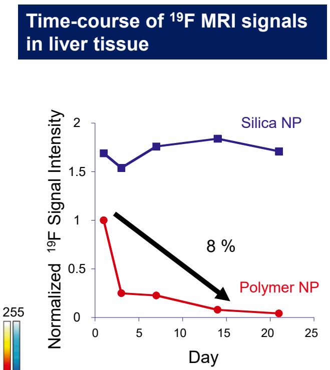




**Patent**

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**Keyword** $^{19}$F MRI, in vivo imaging, nanoparticle