Surface Characterization of Lipid Nanoparticles by NMR Spectroscopy

Lipid nanoparticles (LNPs)

are essential carriers in mRNA-based therapeutics.
Their performance strongly depends on the surface composition – especially the presence and stability of stealth lipids.

Using advanced 1D- and 2D-NMR spectroscopy, surface properties of intact LNPs can be selectively and non-destructively analysed

How It Works

➔ **^{1}H-NMR spectroscopy** with water suppression or pulsed field gradients allows selective qualitative detection of surface-accessible lipids on intact LNPs – by reducing signal overlap from water and small molecules in solution.

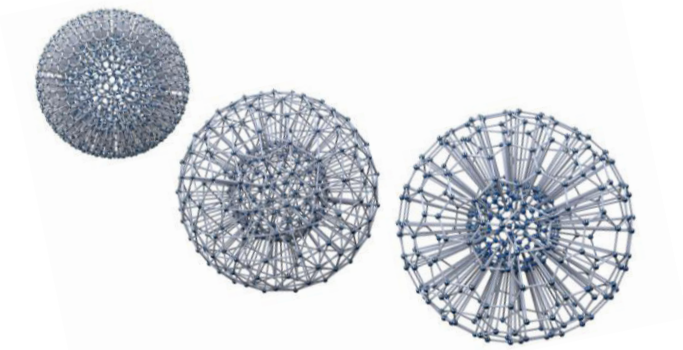
➔ If needed, **disruption of LNPs** enables **quantification** of total lipid composition

➔ **Diffusion-ordered NMR (DOSY)** allows differentiation between LNP-associated and free lipids – supporting the investigation of lipid shedding and stability.

➔ **Surface density studies** of stealth lipids in intact LNPs are currently under active development, aimed at providing quantitative insights into lipid distribution on the particle surface.

Our Service & Applications

- ✓ Targeted investigation of **stealth lipid behaviour** on intact LNPs
- ✓ Support for **formulation development and optimization**
- ✓ **Quantification of surface lipid density** (in development)
- ✓ Early-stage insights into **lipid shedding and surface stability** over time (in development)
- ✓ **Customized method development** tailored to specific lipid systems
- ✓ Collaboration on **emerging analytical approaches**



Contact us: info@spectralservice.de

Actively Exploring New Analytical Pathways

We are continuously working on **new analytical approaches** to better understand LNP surface characteristics. Our current research focuses on DOSY-based lipid dynamics and surface density profiling using NMR spectroscopy. These efforts are not yet routine services – but part of our evolving toolbox for characterizing lipid nanoparticles in a way that reflects both scientific rigor and real-world formulation challenges.

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