Sodium NMR: from pros and cons to material science and hardware developments

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Although often considered elusive, alkali metal nuclear magnetic resonance (NMR) in the solution state remains one of the most valuable techniques for studying coordination and solvation dynamics in materials science. Furthermore, recent years have shown a slow but consistent transition from lithium- to sodium- or potassium-based materials, especially those targeting sustainable solutions.

Meanwhile, green chemistry advancements have reintroduced ionic liquids (ILs), designer solvents from the 20th century, as easily adaptable to various applications due to their negligible volatility, high thermal stability, and high ionic conductivity. Currently, ILs are being investigated as next-generation electrolytes, also compatible with sodium and potassium cations.

This contribution will demonstrate how sodium NMR can be utilized in studies of ILs, providing valuable insights into chemical and electrochemical energy storage applications (1,2). Exotic hardware developments, such as alkali-metal β-NMR spectroscopy (3), or novel study approaches, e.g., biexponential diffusion analysis of ILs (4), will be presented to demonstrate the high relevance of sodium NMR in the field of solvent dynamics.

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(3) R. Harding *et al.,* Phys. Rev. X 2020, 10, 4, p. 041061.
(4) K. Dziubinska-Kuehn *et. al.,* Chem. Methods 2025, *under review*