Solid-State NMR

MAS Broadband CryoProbe for Material Science

Sensitivity Boost for New Challenges in Materials Science

Innovation with Integrity

The Bruker MAS CryoProbe for solids provides **a 3-4 fold mass sensitivity boost**, helping you to acquire spectra **up to 16 times faster** compared to regular room temperature MAS probes. Material science NMR applications which were previously inaccessible by solid-state NMR for reasons of poor sensitivity, particularly for those enquiring low gamma or low natural abundance nuclei, are now possible.

The MAS CryoProbe's game-changing sensitivity enhancement is achieved by cooling the probe's RF components to cryogenic temperatures, which reduces the generation of thermal noise. The sample temperature can be regulated completely independently.

Features:

- X-channel mass sensitivity enhanced by a factor of > 3. Total sensitivity can be up to 10 times higher than with conventional room-temperature MAS probes.
- One order of magnitude faster data acquisition and significantly increased productivity
- Solid-state NMR experiments with strong RF fields
- MAS rates up to 20 kHz with variable temperature capabilities
- Standard bore design (also compatible with WB magnets)
- Optimized special MAS CryoProbe rotors with increased sample volume
- Contact your Bruker representative for additional information.

Application Examples

Conquering titanium, low-gamma and sensitivity

Titanium is one of the most challenging low-gamma nuclei due to the low natural abundance of its NMR-active isotopes ($^{47}Ti/^{49}Ti$). In addition, these two Ti nuclei are very close in frequency, which complicates the spectra through overlapping signals.
The new HX CPMAS CryoProbe offers unique possibilities for $^{47}Ti/^{49}Ti$ NMR spectroscopy, due to the greatly enhanced sensitivity and the larger sample volume of the rotors while still allowing for moderate MAS speeds.

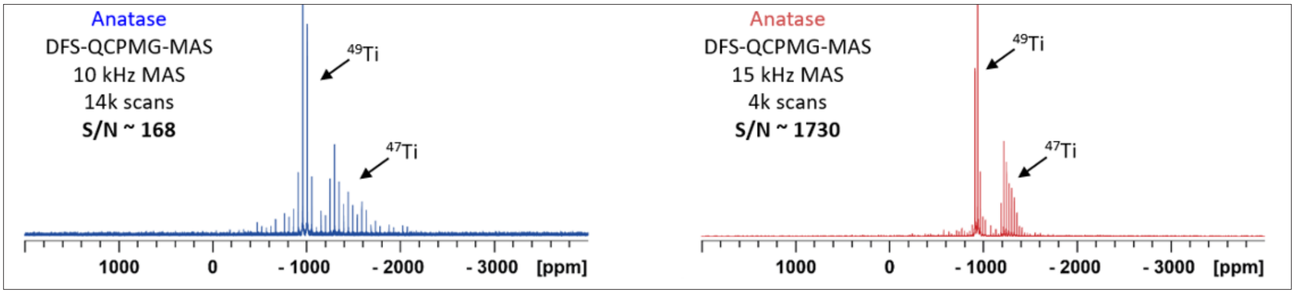

Figure 1 The HX CPMAS CryoProbe delivered a ten fold sensitivity improvement for the analysis of anatase [1].

The excellent sensitivity of the Bruker MAS CryoProbe is illustrated in Figure 1 on the example of ^{47}Ti and ^{49}Ti in anatase, a mineral form of titanium dioxide [1].

Pharmaceuticals: ^{35}Cl wideline QCPMG

More than 50% of APIs are manufactured as HCl salts to stabilize their crystalline forms. The chloride ions in HCl APIs sit in unique environments with intricate hydrogen bonding arrangements reflecting the crystalline molecular structure in its quadrupolar powder pattern, providing a unique spectral fingerprint for each polymorph or pseudo-polymorph containing ^{35}Cl. Since some drug dosage forms contain only a very small amount of the APIs, NMR analysis would require very long acquisition time with conventional NMR probes while the MAS CryoProbe enables data acquisition in a much shorter amount of time, as shown in Figure 2[2].

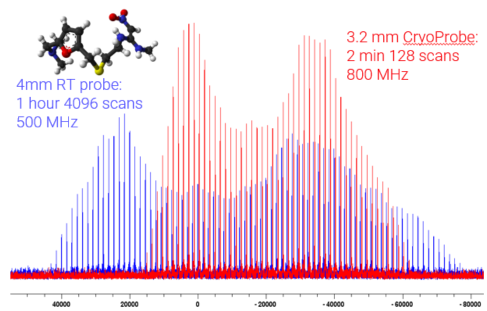

Figure 2: ^{35}Cl WURST-CPMG spectra of a crushed Zantac tablet (150 mg) acquired on a RT probe (blue) and with a MAS CryoProbe (red). The time saving with a MAS CryoProbe in combination with a high field instrument is more than one order of magnitude.

^{67}Zn-NMR: new tool for characterizing MOF

Metal-organic frameworks (MOFs) are being studied for several different important applications, such as catalysis or hydrogen storage. α Zn-formate or α $Zn_3(HCOO)_6$ is a microporous MOF that exhibits promising gas adsorption abilities. The low gamma and low natural abundance of ^{67}Zn makes this nucleus extremely challenging with conventional probes. The enhanced sensitivity of the MAS Cryoprobe allows the acquisition of 2D MQMAS spectra as shown in Figure 3. Such 2D experiments were not possible earlier.

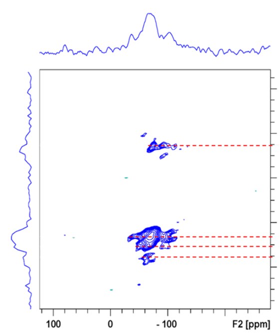

Figure 3: 2D ^{67}Zn MQMAS highlighting the four ^{67}Zn sites of α-$Zn_3(HCOO)_6$, a microporous metal-organic-framework (MOF) that exhibits promising gas adsorption abilities [3].

[1] L. Lätsch, et.al, submitted to JACS, 2022.
[2] Martine Monette, Bruker Application Note.
[3] W. Zhang, et al., submitted to JACS, 2022.

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