

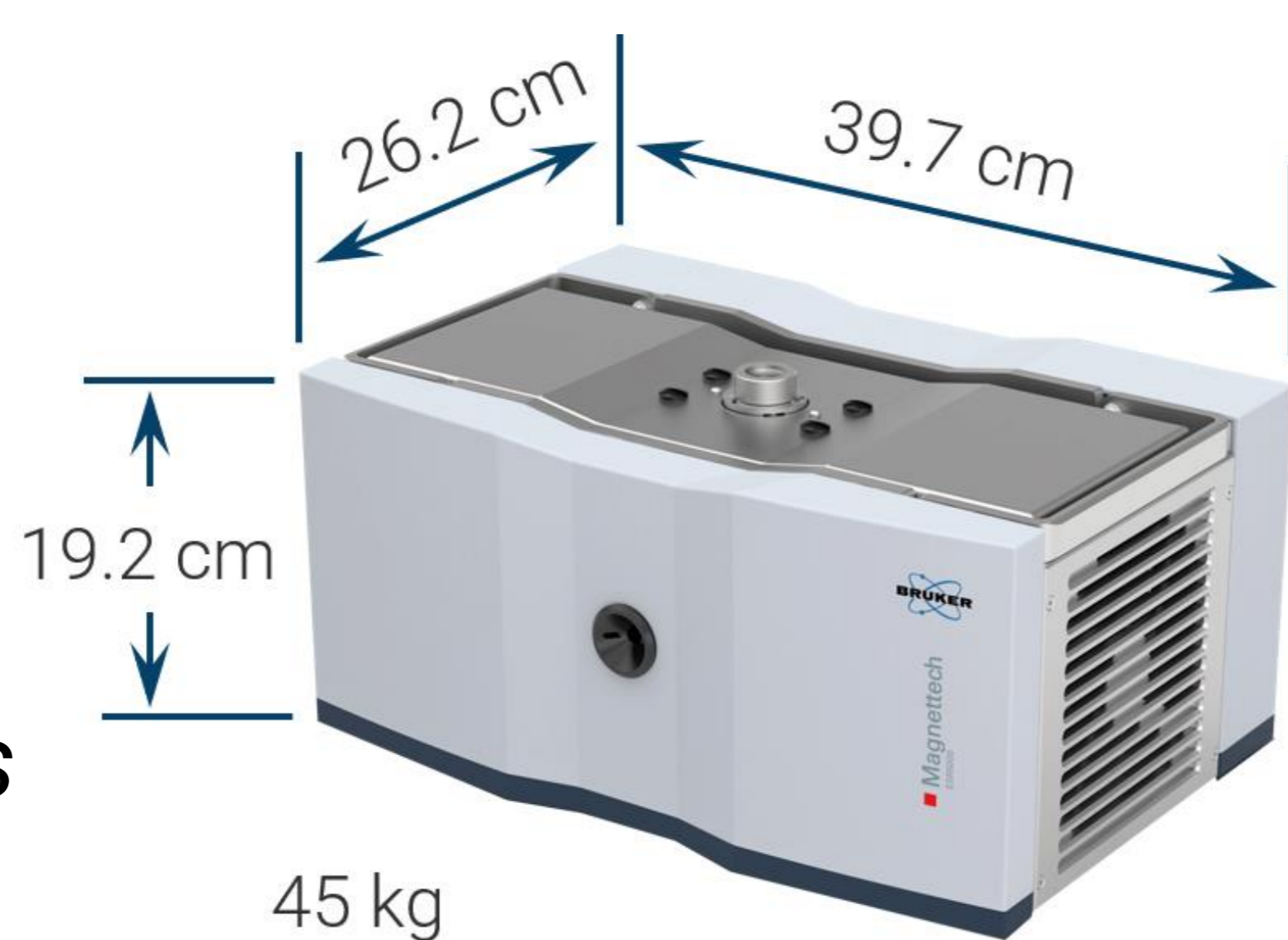
Benchtop EPR for DNP (Dynamic Nuclear Polarization)

Monitoring Polarizing Agents for Improved DNP Performance

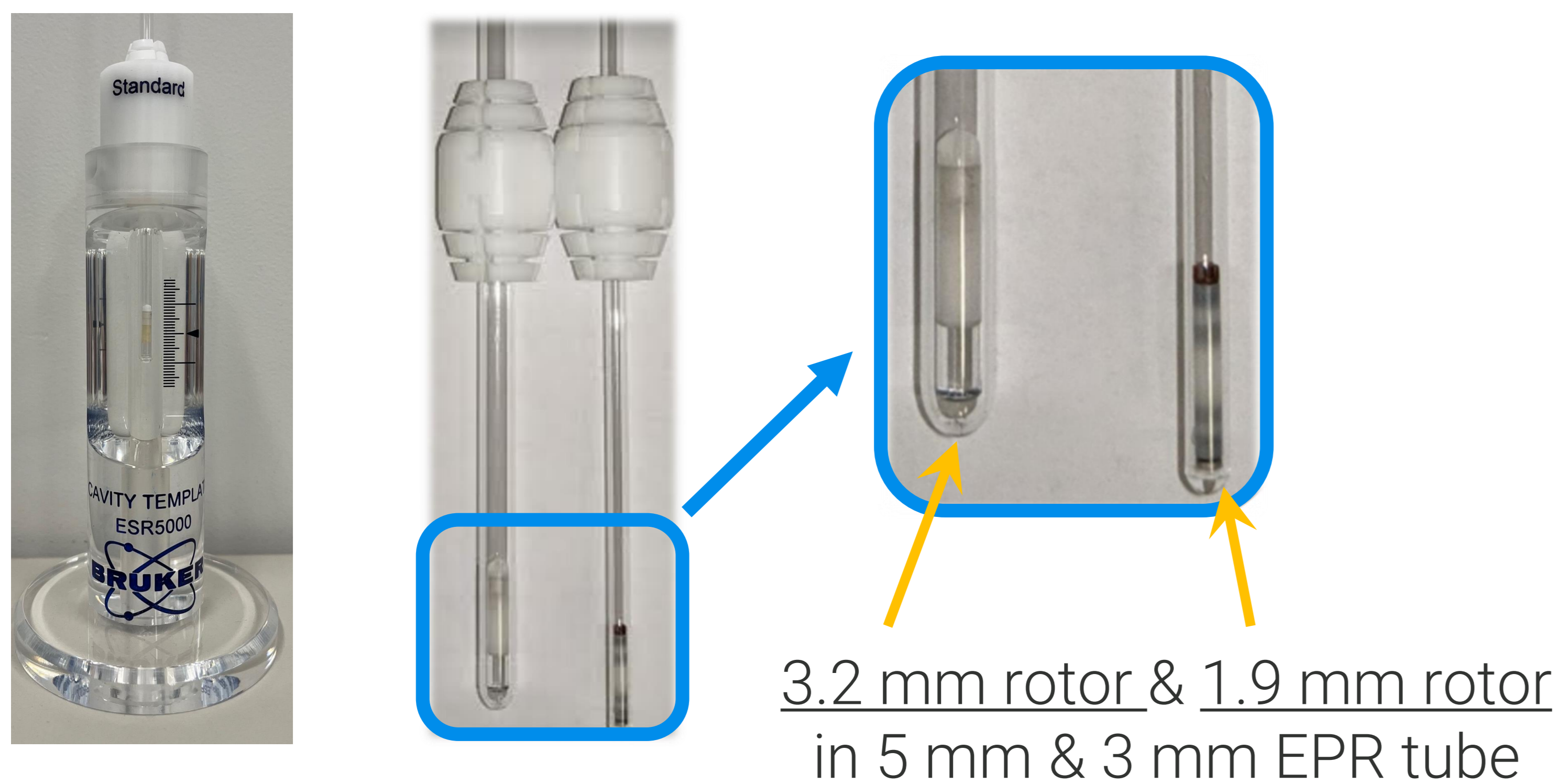
- DNP is a hyperpolarization technique that transfers spin polarization from unpaired electrons (polarizing agents) to nuclear spins.
- DNP efficiency and sample quality may be assessed via EPR signals of the polarizing agent.
- Few-minute experiments on our benchtop system can ensure high-quality DNP in experiments to be run for days and weeks.

Bruker Magnettech ESR5000

- ✓ X-band CW EPR
- ✓ Compact benchtop
- ✓ Stable operation
- ✓ Ideal for measuring DNP polarizing agents



Easy loading of packed MAS rotors



Polarizing Agent Analysis

Polarizing agents studied include molecular free radicals, transition metal ions and endogenous radicals in materials. The ESR500 is well suited to both aqueous & organic solutions.

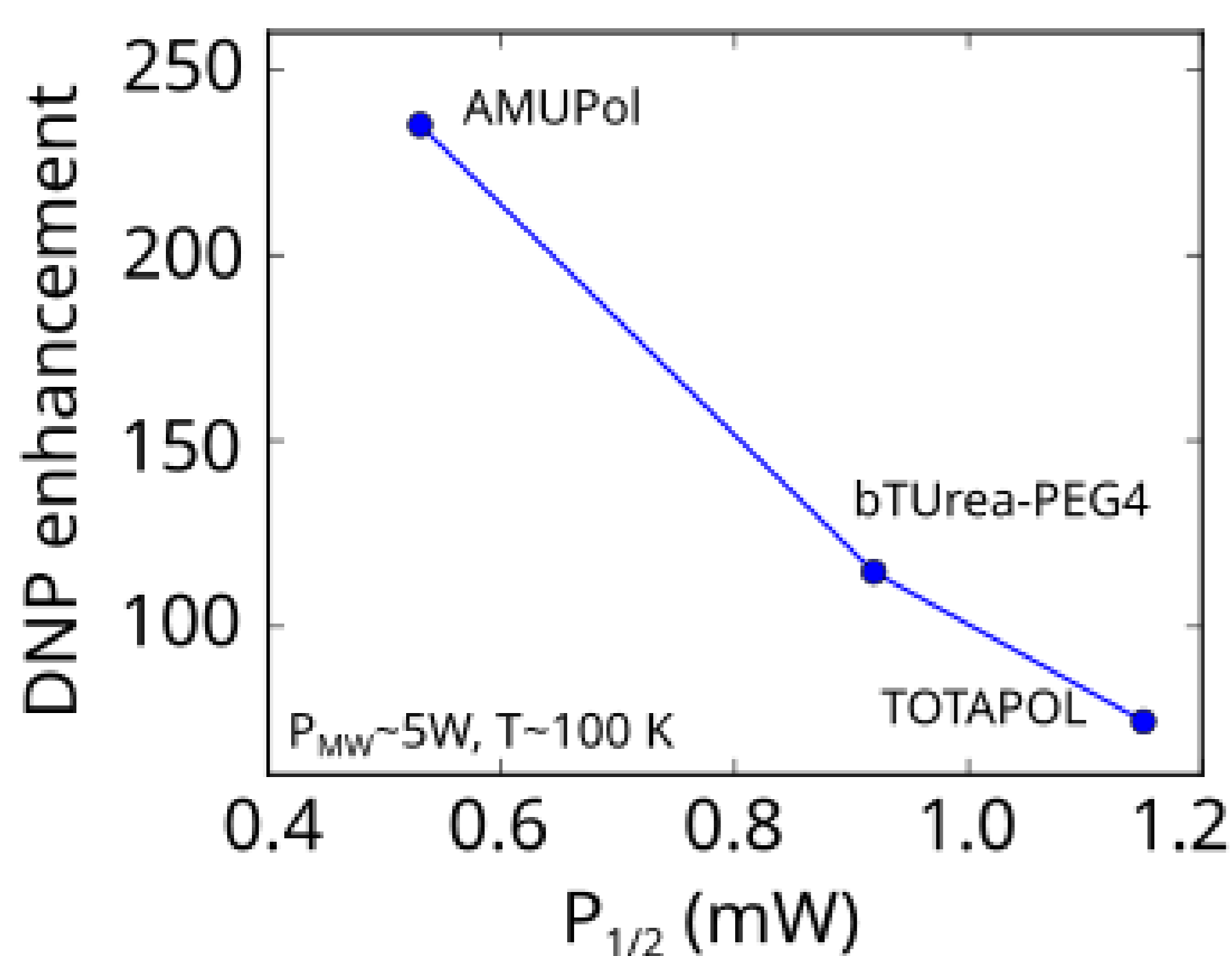


Fig.1 ¹H DNP enhancement vs. $P_{1/2}$ for various radicals. Enhancements at 400 MHz using 5 W microwave power.

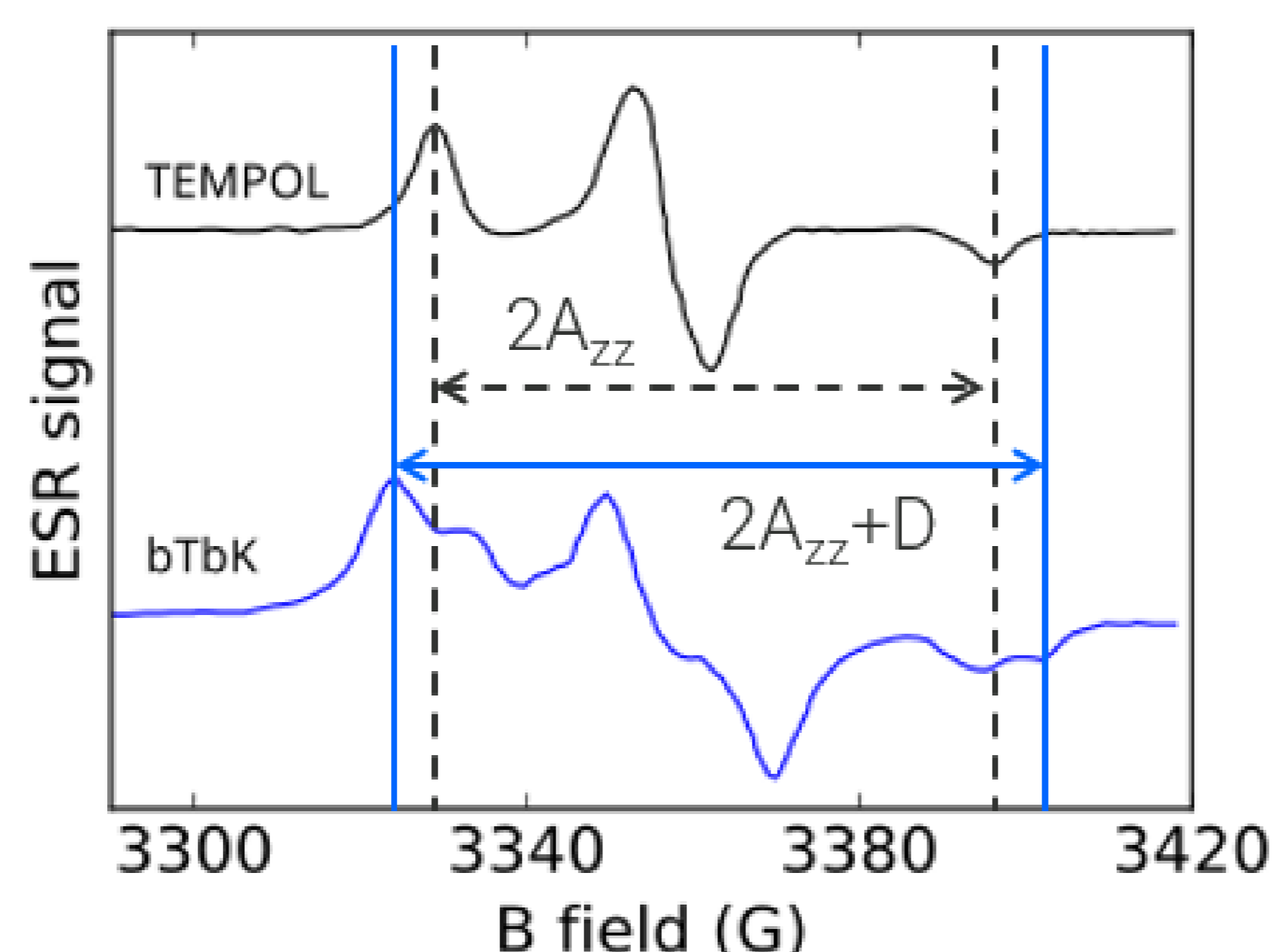


Fig.2 EPR spectra of nitroxide (TEMPO) and bis-nitroxide (bTbK) DNP radicals.

Low-Temperature (LT) Accessories

Various LT accessories are available allowing study of polarizing agents in the T range (ca. 100K) for typical DNP NMR. Accessories include:

- T controller package for EPR of samples from 93 K – 473 K
- LN2 finger dewar for EPR experiments at 77 K

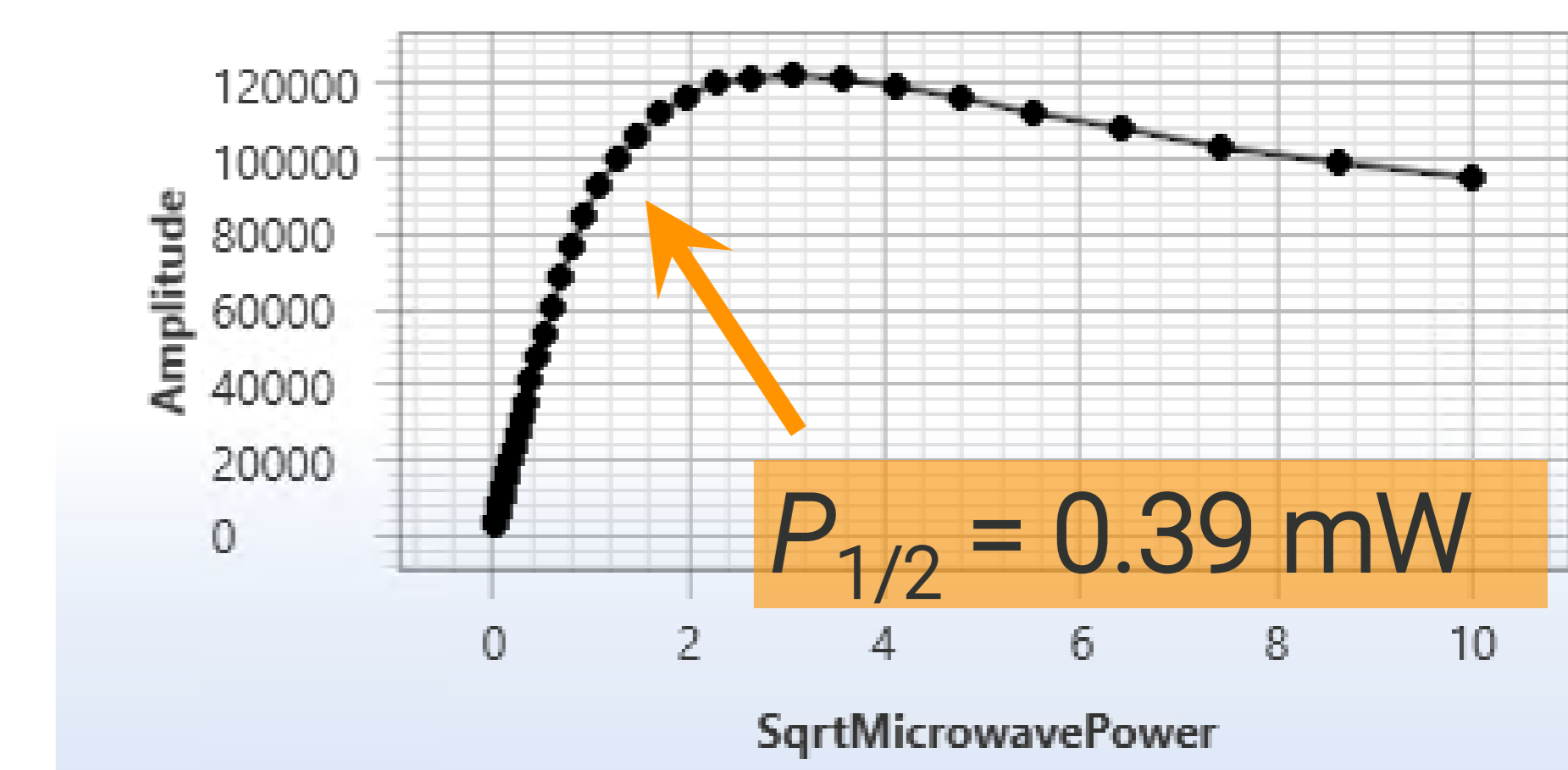


Fig.3 $P_{1/2}$ measurement recorded using temperature controller package.

Spin Counting

Accurate electron spin concentrations are needed to optimize DNP performance & monitor radical degradation.

The *SpinCount* module within *ESRStudio* provides easy, quick assessment of electron spin concentrations in DNP samples without need for an external reference.

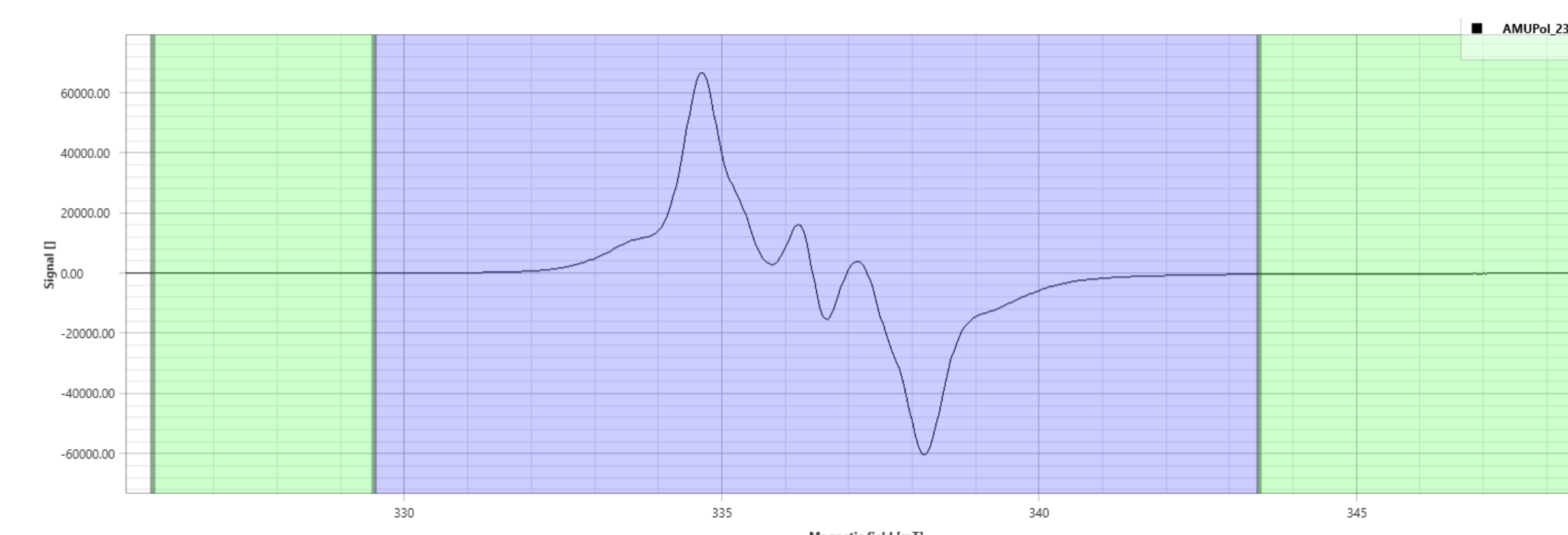
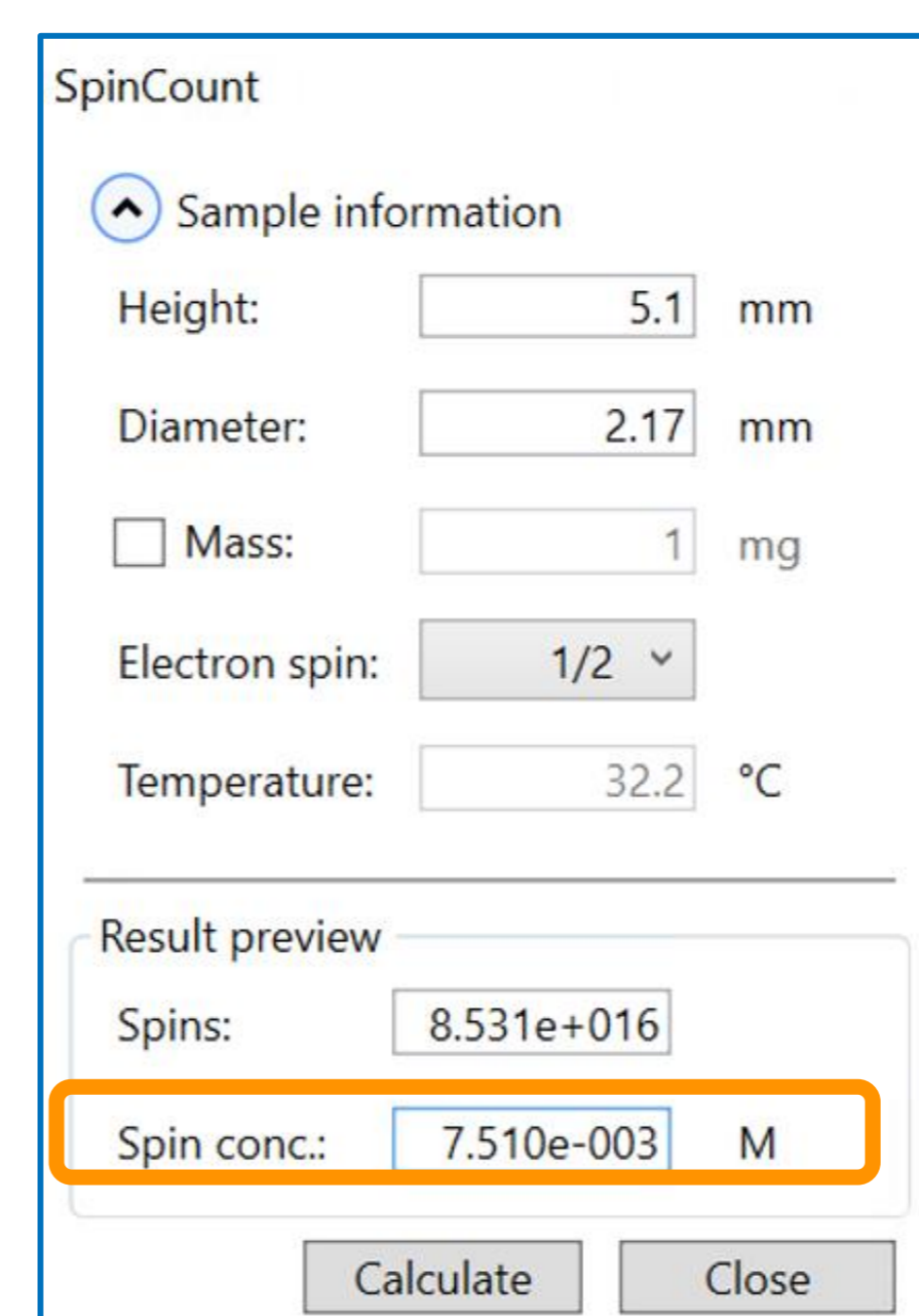


Fig.4 SpinCount calculation to determine the concentration of AMUPol in DNP sample.

Conclusion

- The ESR5000 benchtop is ideal for studying a wide range of DNP polarizing agents
- This includes:
 - predicted DNP performance
 - determination of [radical] & sample lifetime
- LT accessories allow study of DNP agents at <100 K, most relevant to LT-MAS DNP.

TECHNOLOGY & APPLICATIONS