

Interview

How Benchtop NMR technology is accelerating manufacturing: an interview with a chemical laboratory QC manager

Nuclear magnetic resonance (NMR), one of the four major organic spectroscopy techniques, has developed rapidly due to its non-destructive nature, speed, accuracy and resolution. However, due to its high cost, it has not been as widely adopted in industry. In recent years, new benchtop NMR instruments, which are more cost-effective, have evolved to become a valuable supplement to, or replacement for, high field superconducting NMR technology. Adoption in industrial quality control, R&D, teaching and other fields is gradually rising.

Instrument.com.cn, the leading online resource for scientific instruments in China, interviewed a new benchtop NMR customer in industrial quality control, Mr. Xueguang Jin, Quality Assurance Manager of a fluorine chemical manufacturer in Zhejiang Province, China shared details of the justification for investment and use of benchtop NMR spectroscopy and his views on the technology.

During the interview, there were 3 very clear observations when comparing benchtop NMR with GC and ICP (Gas Chromatography and Inductively Coupled Plasma) analysis methods.

1. The procurement cost of benchtop NMR instruments is equivalent.
2. The maintenance cost is lower.
3. Operation is easier.

It was therefore concluded that the applications and adoption potential for benchtop NMR in industry will be widespread.



Here are the details of the discussions:

Instrument.com.cn: Could you please share the reasons why your company decided to purchase a benchtop NMR?

Xueguang Jin: Our company is a joint venture with the parent company in Japan. This year, our company set up a new production project. In the chemical manufacturing process, we need to monitor the process products to ensure the final product quality. For process quality control, we selected benchtop NMR which was recommended by our Japanese parent company. Because benchtop NMR is much simpler, and faster for us, it meets our requirements for production line quality control.

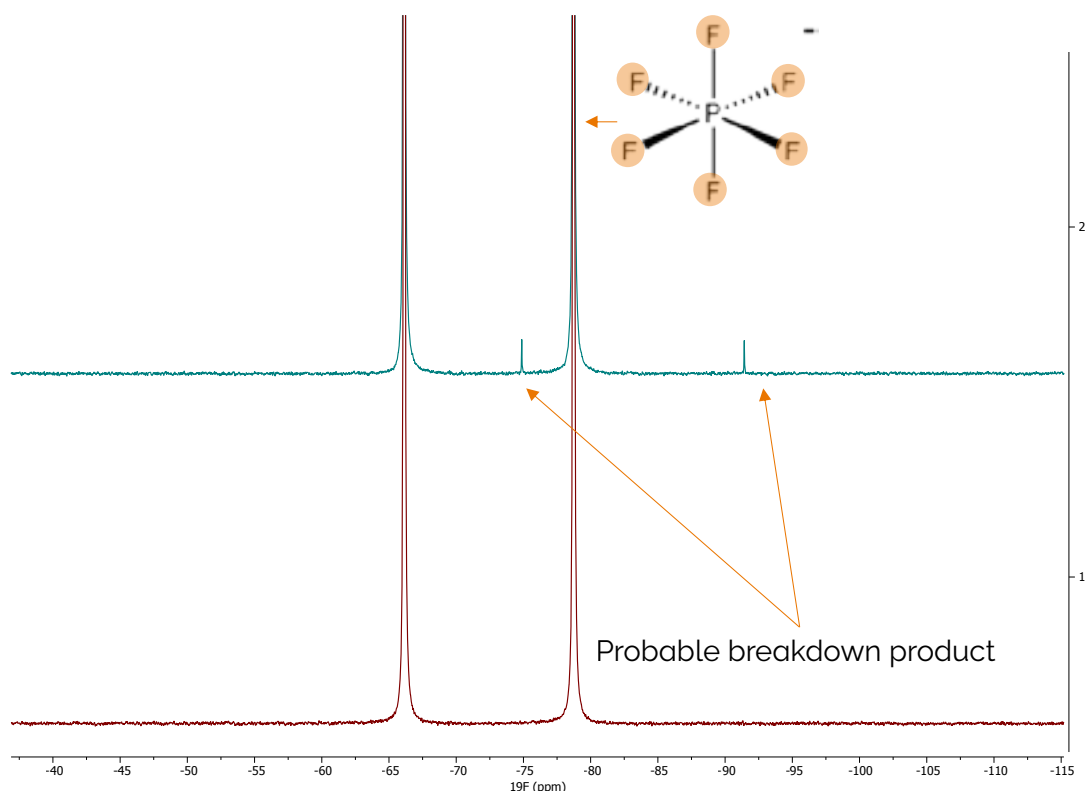
The production team are always focused on the accuracy, stability, and rapid detection performance of any equipment we buy. Based on these indicators, and after comprehensive comparison, we selected the X-Pulse benchtop NMR system from Oxford Instruments.

The installation was completed in July 2020. The final test data was consistent with the standards used by our Japanese headquarters. These are also, required to meet the quality control standards of our company's new production plant in Zhejiang Province.

Instrument.com.cn: How has the X-Pulse NMR performed after installation?

Xueguang Jin: Since the installation of X-Pulse in July, it has been used almost every weekday. In the future, it may be used more frequently in three-shifts with 24-hour uninterrupted operation. Our use frequency is consistently high.

As a production-oriented enterprise, we use X-Pulse to analyze the components of intermediate chemical products in the manufacturing process. We determine the content of intermediate chemicals from their structure to achieve real-time monitoring of final product quality. The production line needs to be tested at very specific time intervals, with every batch being tested,



Two fluorine NMR spectra of a typical battery electrolyte showing the ease of which contaminants can be identified. Data from Oxford Instruments.

Instrument.com.cn: How convenient is it to use X-Pulse?

Xueguang Jin: The X-Pulse is very simple to use. In our new production project, there are so many samples in the production process. It is difficult to accurately determine the content of a certain structural substance in the process step. The benchtop NMR technology recommended by the Japanese headquarters is adopted to make this testing easier and faster.

Now using X-Pulse, we can start to test without sample pretreatment. We add the sample into the NMR tube with a dropper, then move it into the instrument, click scan, and the result is obtained in about 5-10 minutes.

The maintenance of X-Pulse is very minimal - basically no maintenance cost. Having the device boot like a fast computer is also very convenient. Since the installation in July, it has run almost constantly, and its operation is very stable.

Instrument.com.cn: What's your opinion on benchtop NMR?

Xueguang Jin: When we talk about benchtop NMR technology, we can't help comparing it with high field NMR technology.

As industrial users, we focus on the key ownership indicators of instruments. In addition to the acceptable cost, we also need to consider the accuracy, stability and rapid detection of the equipment. Based on these indicators, the advantage of benchtop is very clear.

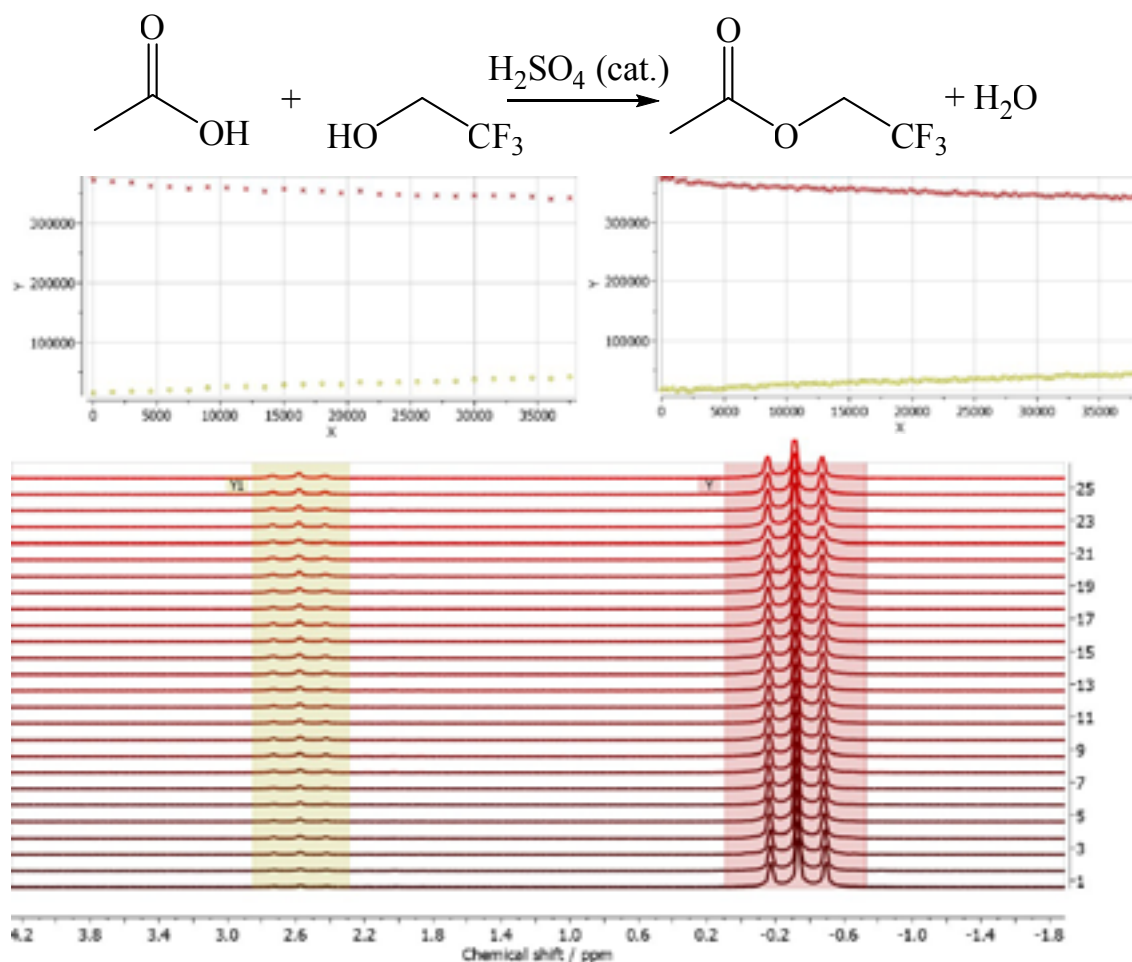
Firstly, the cost price of up to \$1,500,000 prevents most industrial companies from investing in high field NMR. Secondly, the annual operating cost for us of high field NMR is at least \$30,000 which is not a small expense for industrial users, especially for small and medium-sized production enterprises. The emergence of complementary low cost benchtop technology without ongoing operating and maintenance costs enables us to financially justify investing.

Taking X-Pulse as an example, it not only meet our needs for fast testing, accuracy, stability, and other performance indicators, but also enables our enterprise users to save substantial costs. Besides some electricity charges, there is basically no operating cost. In addition, X-Pulse has no cooling equipment and other peripherals, and it does not have special requirements for the installation environment. Just like a computer, it can be installed in a conventional laboratory. There is no need to select floors or set shielding magnetic fields. These factors make it very friendly to industrial users!

Besides chemicals and mixtures, polymers, agricultural products, pharmaceuticals, benchtop NMR spectroscopy can also be used in the automotive field. For example, our company headquarters has applied NMR from Oxford Instruments to the online analysis of the current carrying battery electrolytes used in electric vehicles.

Compared with ICP, GC and other instruments that are more popular in the laboratory, the operation of benchtop NMR with similar cost is simpler, and the applications are also more extensive. We believe that the industrial adoption of benchtop NMR will be accelerate quickly to become a standard technique for both R&D and quality control.





Using fluorine NMR to monitor of an esterification reaction at 18 Celsius between 2,2,2-trifluoroethanol and ethanoic acid. Data from Oxford Instruments

Summary and Outlook:

NMR technology has a strong customer base, high field NMR has been widely used in Colleges and Universities, large central facilities in industry and Government Research Institutions. As a complement to high field NMR and as a dedicated solution, benchtop NMR spectroscopy enables the wider adoption of NMR technology in the middle and low-end industry markets and academic teaching.

This fluorine chemical enterprise in Zhejiang Province has introduced benchtop NMR technology into their production line. With the combined promotion of users and instrument manufacturers, the rise of benchtop NMR technology across many industries will become a trend.

If you have any questions about this article, please contact our experts: magres@oxinst.com

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