Moving from Helium to Hydrogen as a Carrier Gas for the Thermo Scientific ISQ GC-MS System

Introduction

The purpose of this technical brief is to demonstrate the use of hydrogen as a carrier gas for GC-MS rather than the traditional use of helium. The world-wide shortage of helium has prompted many labs to investigate the feasibility of adopting the use of hydrogen as a carrier gas. The availability of hydrogen generators provides a safe, steady, and renewable supply of hydrogen for proper instrument operation. This brief summarizes what is needed to transition your ISQ™ GC-MS system to use hydrogen as a carrier gas. For more details and a discussion of how changing the carrier gas affects chromatography, please refer to the full application note (AN52362: Moving from Helium to Hydrogen as a Carrier Gas for GC-MS Applications: Practical Considerations).

Experimental Conditions

The ISQ GC-MS system used in this study was paired up with a Thermo Scientific TRACE 1300 GC equipped with a split/splitless injector and Thermo Scientific Xcalibur control software. The EI and CI modes with hydrogen carrier gas were both tested using a Thermo Scientific TG-SQC test column 30 m × 0.25 mm id × 0.25 um. (The comparative data with helium as carrier gas are shown for TG-SQC test column 15 m × 0.25 mm id × 0.25 µm). The GC-MS parameters were set to typical operating conditions with only some slight changes to accommodate for the carrier gas differences. A Thermo Scientific hydrogen sensor was installed and set to alarm if a hydrogen leak occurred inside the GC oven. A cylinder of UHP hydrogen was used in this case, but a UHP hydrogen generator is recommended for safety reasons. For GC-MS, it is best to use a generator with a palladium diffusion dryer, otherwise the gas stream will have excessive water vapor. The maximum amount of moisture must be below 1 ppm. Examples of hydrogen generators may include, but are not limited to the following: Parker Balston® H2PD Series (http://www.labgasgenerators.com/hydrogengenerators) and F-DGS® WM-H2 Series (http://f-dgs.com/uk/hydrogen_uk.htm.)*

The system sensitivity was such that a 1 µL injection of 1 pg/µL standard yielded a signal-to-noise (S/N) ratio of at least 100:1 (Figure 1) for octafluoronaphthalene (OFN) in EI mode. Chemical Ionization (CI) yielded S/N of at least 300:1 (Figure 2) and 600:1 (Figure 3) for 100 pg benzophenone and 200 fg OFN respectively.

Results and Discussion

The sensitivity in the EI mode with the hydrogen carrier is 3–4 times lower than helium due to the increase in background noise. The CI mode, however, does not produce this effect and yields typical S/N values that are comparable to those observed with helium. Depending on the application used, the oven ramp and/or column dimensions will have to be adjusted to account for the lower viscosity of hydrogen.

Conclusion

It has been demonstrated that the ISQ GC-MS can be safely (taking all necessary safety precautions) converted to use hydrogen as carrier gas rather than helium. Depending on the complexity of the application, the GC parameters will require adjustment to accommodate the differences between the two gases. For a list of recommended part numbers for converting the system to use hydrogen and a detailed technical discussion, including van Deemter curve plots and comparisons of various chromatograms and conditions, please refer to the corresponding application note (AN52362: Moving from Helium to Hydrogen as a Carrier Gas for GC-MS Applications: Practical Considerations).

* Thermo Fisher Scientific does not endorse, guarantee, or warranty the use, suitability, or performance of any third party equipment. The models mentioned are examples only.

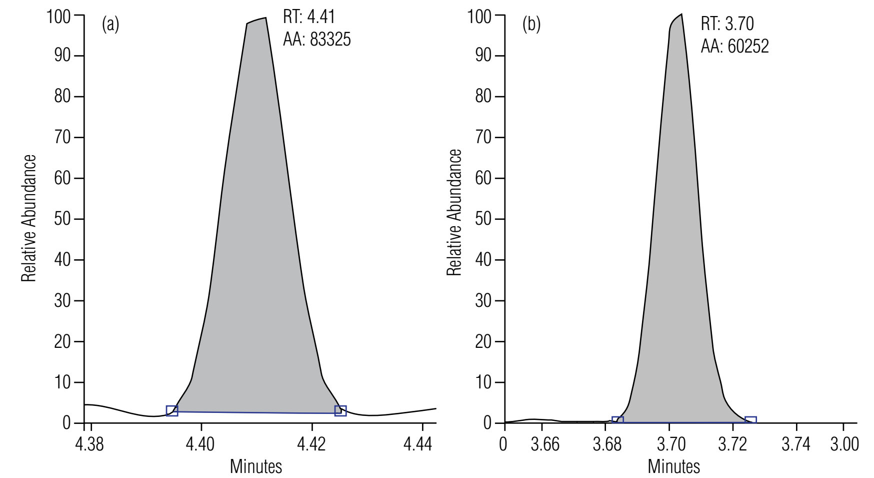

Figure 1. Injection of 1 pg/µL OFN in EI mode results in S/N of at least 100:1 for hydrogen (a.) vs. 600:1 for helium (b.).

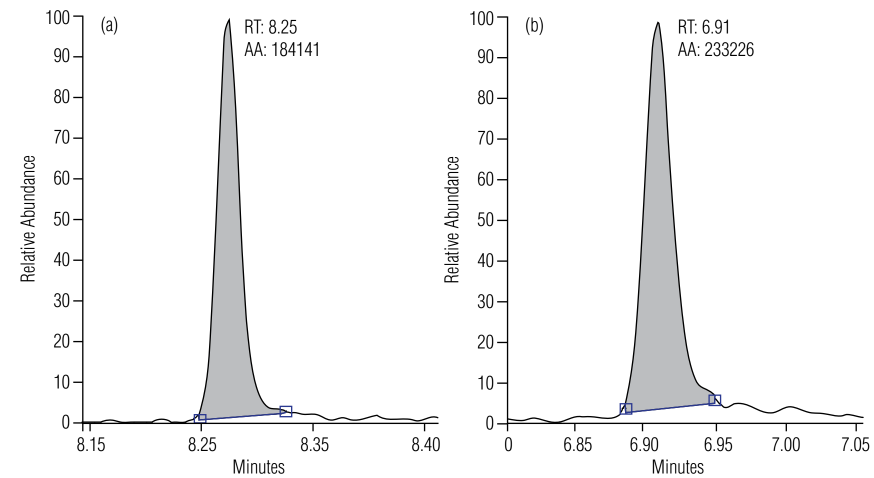

Figure 2. Injection of 100 pg/µL benzophenone in CI mode results in S/N of at least 300:1 for both hydrogen (a.) and helium (b.).

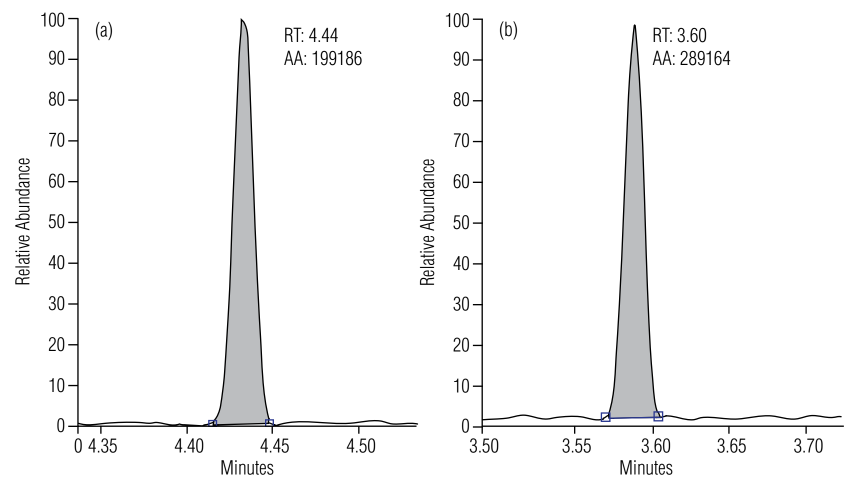

Figure 3. Injection of 200 fg/µL OFN in CI mode results in S/N of at least 600:1 for both hydrogen (a.) and helium (b.).

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