NMR Spectroscopy

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BACKGROUND:

Developed in the 1940s, Nuclear Magnetic Resonance (NMR) is a widely used spectroscopy technique in the study of the structures of organic compounds. The sample placed in the NMR is exposed to a pulse of radiation, and the nuclei of the sample then absorb this radiation's energy. The nuclei emit a signal with a specific frequency depending on the energy absorbed. These signals produce two types of spectra – carbon spectra (^{13}CNMR) and hydrogen spectra (^{1}HNMR).

HOW TO INTERPRET NMR SPECTRA:

Each set of chemically equivalent hydrogen or carbon nuclei produce a signal that is split by any adjacent hydrogen nuclei that may be present. Chemical shift, splitting, and integration of signals is used to determine functional groups.

HOW TO OBTAIN NMR SPECTRA:

1) Place the sample of interest in an NMR tube.
2) Place the tube in the top of NMR and use the program to lower the sample into unit (unit shown in Figure 4).
3) Run the appropriate set-up procedures.
4) Start the sample analysis.
5) Use the software on the computer to create and print out the spectra.

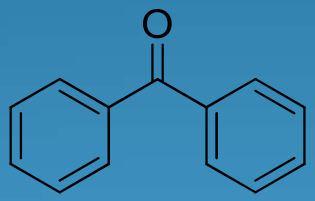

Figure 3: Benzophenone

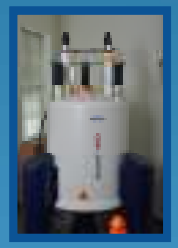

Figure 4: NMR spectrometer

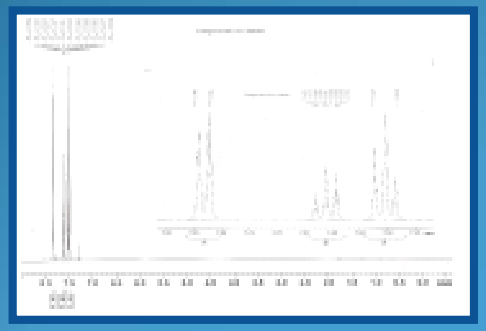

Figure 1:
^{1}HNMR spectra of benzophenone.

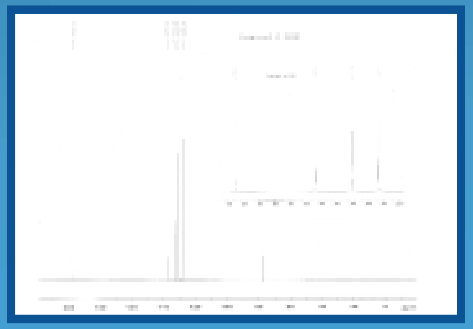

Figure 2
^{13}CNMR spectra of benzophenone.

Figure 5:
Filling the NMR with liquid nitrogen.

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NMR MAINTENANCE:

The NMR spectrometer contains a magnet coil that is enclosed in a container filled with liquid helium. The liquid helium container is surrounded with a can filled with liquid nitrogen to prevent the helium from rapidly boiling away. These two cryogens, liquid helium and liquid nitrogen, are used to keep the superconducting coils that power the magnet cooled below its critical superconducting temperature.

Our job is to maintain the appropriate level of liquid nitrogen – this involves carefully setting up and monitoring the filling procedure as shown in Figure 5. This is done once a week.

USES IN FUTURE RESEARCH:

NMR spectroscopy is invaluable in research because it provides an efficient way to analyze the chemical structure of compounds. Hydrogen and carbon NMR spectra will be used to determine the chemical structure of organic compounds we will synthesize in the laboratory.

REFERENCES:

Bruice, Paula Yurkanis. *Organic Chemistry*. 6th. New York: Prentice Hall, 2011. 553-603. Print.