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Video Review

Interpreting Infra-Red and NMR Spectra

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Interpreting Infra-Red and NMR spectra. Presented by D. J. Chadwick and R. Lyon; produced by the University of Liverpool. Published by The Royal Society of Chemistry, Letchworth, England SG6 1HN. Running time 40 mins. VHS or Beta format (PAL only). Price 29 pounds.

This video has been designed to assist students in the interpretation of IR and NMR spectra. This type of skill development is essential to the modern chemist who routinely needs to employ a range of spectroscopic methods for the structural elucidation of new compounds.

The video consists of a discussion between a student, who is having difficulties interpreting spectra, and a tutor, whilst observing various spectra of organic compounds. Unfortunately, the interchange between student and tutor is extremely formal and the majority of the spoken communication is carried out by the tutor. This feature would have been much more effective if the student had brought her own spectra to the meeting and taken a more active part in the discussion.

During the interpretation of IR spectra, it is valuable to correlate experimental spectra with the underlying theory. Diagrammatic representation of many of the molecules discussed in the video is a positive feature.

On the other hand, there are a number of features that limit the value of the video. The student refers to the measurement of IR spectra in absorbance mode, though most IR spectra, including all of those shown in the video, are recorded in percent transmission. The explanation of characteristic frequency ranges for different functional groups is clear, and the effects of recording spectra in two different media are also well demonstrated. However, the use of CCl_4 as a solvent is somewhat dated, and no reference is made to obtaining spectra in KBr disks. In addition, the inability of the audience to see the result of the student writing down the frequency ranges indicates that this feature is of little value, and correlation tables are well documented elsewhere. Further, much of the written information on both IR and NMR spectra is difficult to read throughout.

Turning to more technical issues, the reason why single bonds connecting light atoms vibrate at high energy is inadequately explained; the structure of CH_3NO_2 indicates that the nitrogen is pentavalent, which is clearly confusing. The explanation of the different C–O stretching frequencies for carbonyl compounds (ketones, carboxylic acids, etc.) is detailed and clear, though once again some of the visual features (e.g., wavenumber scale) are impossible to see.

In discussing proton NMR spectra, it is not made clear why high-field protons resonate at low chemical shifts.

This is a concept that students often find confusing. Nor is it clear how integration is used to determine the number of protons giving rise to a specific resonance. The choice of cyclopentene to illustrate alkene resonances is not a good one. Although the equivalence of the alkene protons is satisfactorily dealt with in terms of symmetry arguments, most students will be confused by the lack of coupling between the alkene protons and the CH_2 protons.

The *n*+1 rule is referred to without any mention of its limitations (i.e., the requirement for equal coupling constants). This feature becomes particularly apparent when the spectrum of butanol is illustrated. The description of the resonances for the β and γ protons in this molecule as "very complicated" is unclear in light of the *n*+1 rule, and students find this type of description both unsatisfactory and confusing. The comment stating that equivalent hydrogen nuclei do not couple with each other is a clear error.

One limitation of writing down chemical shift ranges for different proton types is illustrated by the spectrum of cinnamic acid, where the two alkene protons resonate to the high- and low-field side of the aromatic protons. This should either have been explained or a different example chosen. Finally, there is an further overuse of the term "complicated splitting pattern" when describing the NMR spectra of 1,2-disubstituted benzenes. Since the section of the video covering NMR was introduced by highlighting the power of this technique in structural elucidation, care should be taken to either illustrate concepts with examples that are consistent with these areas and/or offer a more comprehensive explanation of more complex spectral features when they arise. Cursory explanations only add to student confusion.

In conclusion, it should be considered what role this video might play in advancing students' understanding of interpreting IR and NMR spectra. There is insufficient detail for it to replace a taught course, and it contains little information that cannot be obtained in standard texts covering these techniques. The style of presentation is unimaginative and many of the visual aids are difficult to see. The technical content is mixed. Although some concepts are explained well, others will lead to confusion in students' minds rather than clarification. A tutor may recommend this video to students as a revision aid, though they should be prepared to address several follow-up questions, particularly from university-level students.