

# Infrared Absorption Spectroscopy

## 3.1 Introduction

Infrared spectroscopy is one of the most powerful analytical techniques which offers the possibility of chemical identification. This technique when coupled with intensity measurements may be used for quantitative analysis. One of the most important advantages of infrared spectroscopy over the other usual methods of structural analysis (X-ray diffraction, electron spin resonance, etc.) is that it provides useful information about the structure of molecule quickly, without tiresome evaluation methods. This method can solve many problems in organic chemistry and coordination chemistry, while in some other problems infrared data advantageously complement the results obtained by other methods.

Infrared spectroscopy has established itself as a valuable tool for the determination of organic, and to a lesser extent, inorganic, structure. The utilization of infrared data in conjunction with other physical measurements, such as those obtained from nuclear magnetic resonance and mass spectroscopy, has elucidated many facts about the structure and properties of organic compounds, facts which were heretofore accepted solely on a theoretical basis.

Infrared spectroscopy may be applied at all levels of expertise from a simple matching of spectra on one end to theoretical calculations at the other. The instruments are common, relatively inexpensive, and easy to operate. This, combined with the non-destructive nature of the analysis, means that records on intermediate preparative or separation products may be easily obtained. The sample may then be recovered and further utilized. While qualitative applications are most common, the absorption of infrared radiation does follow Beer's Law and therefore lends itself to quantitative determinations.

The technique is based upon the simple fact that a chemical substance shows marked selective absorption in the infrared region. After absorption of IR radiations, the molecules of a chemical substance vibrate at many rates of vibration, giving rise to close-packed absorption bands, called an IR *absorption spectrum* which may extend over a wide wavelength range. Various bands will be present in a chemical substance, which will correspond to the characteristic functional groups and bonds present in a chemical substance. Thus, an IR spectrum of a chemical substance is a fingerprint for its identification.

Band positions in an infrared spectrum may be expressed conveniently by the wave number  $\bar{\nu}$ , whose unit is  $\text{cm}^{-1}$ . The relation between wave number  $\bar{\nu}$ , wavelength  $\lambda$  and frequency  $\nu$  is as follows

$$\nu = c/\lambda$$

$$\bar{\nu}(\text{cm}^{-1}) = \nu/c = 1/\lambda$$

where  $c$  is the velocity of light. From the above relations, it follows that wave number is the reciprocal of wavelength.

Band intensities in IR spectrum may be expressed either as transmittance (T) or absorbance (A). Transmittance is defined as the ratio of radiant power transmitted by a sample to the radiant power incident on the sample. On the other hand, absorbance is defined as the logarithm, to the base, 10, of the reciprocal of the transmittance, i.e.,

# Chatwal Pharmaceutical Analysis

**Jin-Ying Zhang**



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method for simultaneous estimation of ciprofloxacin hydrochloride and dexamethasone in combined dosage form which is a better alternative to existing ones The developed analytical methods are simple selective accurate robust and precise with shorter analysis time for the analysis of drugs in combined pharmaceutical dosage forms All the developed HPTLC and HPLC methods have been validated as per ICH Q2 R1 guideline Developed analytical methods could boost analytical researchers to work more efficiently in the field of analytical method development and validation of Pharmaceutical dosage forms

**Pharmaceutical Chemistry - Inorganic (Vol. I).** G. R. Chatwal, 2010 The present book Pharmaceutical Chemistry Inorganic Vol I has been written according to the revised syllabus framed by the Pharmacy council of India as per Education Regulations 1991 In this book subject matter has been recognised incorporating applicationwise classification Therapeutic pharmaceutical etc rather than the traditional chemical classification More emphasis has been further laid by explaining the medical and pharmaceutical terms and to what extent it is justifiable to classify a compound under any of the categories Inevitably students will find repetition for some compounds

**Pharmaceutical Analysis E-Book** David G. Watson, 2012-07-15 An introductory text written with the needs of the student in mind which explains all the most important techniques used in the analysis of pharmaceuticals a key procedure in ensuring the quality of drugs The text is enhanced throughout with key points and self assessment boxes to aid student learning Features Includes worked calculations to demonstrate mathematics in use for pharmaceutical analysis Focuses on key points rather than a large number of facts to help readers really understand the field as well as pass exams Includes self assessment focussing on simple arithmetical calculation results from analytical data Additional section on basic calculations in pharmaceutical analysis More detail on the capillary electrophoresis of proteins A discussion of some of the new types of HPLC column and on solvent selectivity in HPLC Additional material inserted on the control of the quality of analytical methods mass spectrometry and high pressure liquid chromatography Additional self assessment exercises

Pharmaceutical Analysis, 2003 Essentials of Pharmaceutical Analysis Muhammad Sajid Hamid Akash, Kanwal Rehman, 2019-12-17 Recent advances in the pharmaceutical sciences and biotechnology have facilitated the production design formulation and use of various types of pharmaceuticals and biopharmaceuticals This book provides detailed information on the background basic principles and components of techniques used for the analysis of pharmaceuticals and biopharmaceuticals Focusing on those analytical techniques that are most frequently used for pharmaceuticals it classifies them into three major sections and 19 chapters each of which discusses a respective technique in detail Chiefly intended for graduate students in the pharmaceutical sciences the book will familiarize them with the components working principles and practical applications of these indispensable analytical techniques

*Indian Books in Print*, 2003 **A Textbook of Pharmaceutical Analysis** Kenneth Antonio Connors, 1967 **Handbook of Modern Pharmaceutical Analysis** Satinder Ahuja, Stephen Scypinski, 2010-11-11 Handbook of Modern Pharmaceutical Analysis Second Edition synthesizes the complex research and recent changes in the field while covering the

techniques and technology required for today's laboratories. The work integrates strategy, case studies, methodologies, and implications of new regulatory structures, providing complete coverage of quality assurance from the point of discovery to the point of use. Treats pharmaceutical analysis (PA) as an integral partner to the drug development process rather than as a service to it. Covers method development, validation, selection, testing, modeling, and simulation studies combined with advanced exploration of assays, impurity testing, biomolecules, and chiral separations. Features detailed coverage of QA, ethics, and regulatory guidance, quality by design, good manufacturing practice, as well as high-tech methodologies and technologies from lab-on-a-chip to LC-MS, LC-NMR, and LC-NMR-MS.

**A Textbook of Pharmaceutical Analysis, 3rd Ed** Kenneth A. Connors, 2007-09. Market\_Desc: For undergraduate courses in pharmaceutical analysis. Graduate students and professional pharmacists will find it a useful reference. About The Book: This book is a detailed systematic treatment of analytical chemistry focusing on drug analysis. It covers both classical techniques and modern approaches. It includes new sections on immunoassay, derivative formation, and statistical interpretation of data. Also includes an expanded treatment of liquid chromatography as well as over 250 problems, many with solutions provided.

*A Textbook of Pharmaceutical Analysis* Kenneth A. Connors, 1982-09-16. A Practical Guide to Molecular Cloning. By Bernard Perbal. Presents detailed procedures for all phases of DNA cloning experiments. Starting with laboratory equipment and safety considerations, this practical guide goes on to describe enzymes, vectors, purification, and characterization techniques, genetic mapping, modification of DNA fragments with cohesive termini, ligation, preparation of genomic libraries, sequencing of DNA, and more. 1984. 554 pp.

Pharmaceutical Calculations 2nd Ed. By Joel L. Zatz. Expanded and updated, this examination of pharmaceutical calculations features a programmed format designed for fast-paced learning and a progression of topics that builds on previous instruction. The second edition of this popular text includes current unit designations and abbreviations, additional material on the alligation technique and infusion calculations, and many new problems. 1981. 388 pp.

Drug Level Monitoring Volume 2: Analytical Techniques, Metabolism, and Pharmacokinetics. By Emil T. Lin and Wolfgang Sadler. The second volume in a series that describes drug level assays in biological fluids. Reviews of the analysis, metabolism, and pharmacokinetics of 16 major classes are included. Details are presented on therapeutic drug concentrations in plasma, pharmacokinetic parameters, and a large number of drug assay procedures applicable to biological specimens. All of these subject areas have been carefully combined to render this book a unique reference source, teaching tool, and guide to drug level monitoring. 1985. 250 pp.

**Pharmaceutical Drug Analysis** Ashutosh Kar, 2005. Introduction to Pharmaceutical Analytical Chemistry Stig Pedersen-Bjerggaard, Bente Gammelgaard, Trine G. Halvorsen, 2019-02-11. The definitive textbook on the chemical analysis of pharmaceutical drugs, fully revised and updated. Introduction to Pharmaceutical Analytical Chemistry enables students to gain fundamental knowledge of the vital concepts, techniques, and applications of the chemical analysis of pharmaceutical ingredients, final pharmaceutical products, and drug substances in biological fluids. A unique emphasis on pharmaceutical

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**Pharmaceutical Analysis** P. D. Chaithanya Sudha,2012 Pharmaceutical Analysis is a compulsory subject offered to all the under graduate students of Pharmacy This book on Pharmaceutical Analysis has been designed considering the syllabi requirements laid down by AICTE and other premier institutes universities The book covers both the Titrimetric and Instrumental aspects of Pharmaceutical analysis which is helpful for use in multiple semesters

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