# Introduction

This comprehensive collection of Infrared Spectra has been designed and laid out to ensure that it is as easy to use as possible. For example, plastics and rubbers have been given their own separate sections and these are sub-divided into separate sections for transmission and pyrolysate spectra. Infrared spectra generated using the popular single bounce attenuated total refection (ATR) accessory are also given their own specific section.

A clear classification system has been used throughout and, to aid manual searching, material indexes have been placed at the end of each of the five individual sections. There are also comprehensive material and tradename indexes at the end of the library.

#### Recording and presentation of the spectra

Spectra have been collected and stored at a resolution of 4 cm<sup>-1</sup> and are plotted as percentage transmittance against wavenumber. For the transmission and pyrolysate spectra, the wavenumber range shown is 400 to 4000 cm<sup>-1</sup>, whereas for the single bounce, diamond window ATR spectra the range is 650 to 4000 cm<sup>-1</sup>. All of the spectra display the traditional change in the wavenumber scale at 2000 cm<sup>-1</sup>. Up to 2000 cm<sup>-1</sup>, each minor division (denoted by a broken line) on the wavenumber axis is equal to 50 cm<sup>-1</sup>, but from 2000 to 4000 cm<sup>-1</sup> each minor division is equal to 100 cm<sup>-1</sup>.

With respect to the layout of the spectra in the book, within each section they are listed in alphabetical order according to material type, which is displayed in the main heading (in bold) above each spectrum. There are some deviations from a strict adherence to this rule. For example, acrylonitrile-butadiene rubber is referred by most people in the polymer industry as nitrile rubber and so it has been positioned accordingly. Such deviations are covered by cross-referencing entries in the indexes at the end of the respective sections as well as in the overall index at the end of the book. Where samples consist of a blend of polymers, the proportions of the polymers in the blend has also been shown in this main heading. In cases where there are three polymers in a blend, the values displayed do not always add up to 100 (e.g., 50:40:30). In these instances, the proportions present in the material are designed to achieve a particular set of properties in a final product, i.e., they are not analytical standards.

Each spectrum also has a secondary heading, where as much additional information as possible has been provided. This information includes things such as the tradename of the material, its manufacturer, compositional information (e.g., sulfur cured), and the method of preparing the sample (e.g., film cast from chloroform) for the recording of the spectrum. Unfortunately, because the samples for this book

have originated from a wide range of sources, certain pieces of additional information, such as the tradename and manufacturer, have not always been available.

With respect to the recording of the spectra, the experimental approach that was used to produce each of the three types of spectra that are presented in this book is summarised below.

#### Transmission spectra

Two different approaches were used to record transmission spectra:

- a) A thin film was produced by hot pressing the sample at a suitable temperature. If the sample was a plastic, or thermoplastic rubber, a temperature greater than the glass transition temperature of the material was used. In the case of semicrystalline plastics, a temperature above the melting point of the material was used. The spectra were then recorded directly through the film.
- b) A part of the sample was dissolved in a suitable solvent (e.g., chloroform) and a thin film produced on a potassium bromide infrared plate by placing some of the solution onto it and removing the solvent in an oven. The dried plate with the cast film on its surface was then placed into the spectrometer to record the spectrum.

In both cases, care was taken to ensure that the sample did not undergo any chemical change due to heat degradation.

## Pyrolysate spectra

In those cases where the sample was in a crosslinked state (e.g., cured rubbers, cured adhesives and thermoset compounds), it was not possible to use either of the transmission approaches described above and so the Rapra pyrolysate method was employed. A brief description of this method is given next.

In the case of compounded materials (e.g., most rubbers), an initial 16 hour Soxhlet extraction was performed on a thin film generated by a laboratory handmill using an appropriate solvent (e.g., acetone) to remove any low molecular weight compounds (e.g., plasticisers, process aids, cure system residues and antidegradants) from the sample. Failure to remove such low molecular weight species adversely affects the quality of the resulting infrared spectrum as they contribute to it. The extracted portion of the sample was then pyrolysed over a Bunsen burner in a modified ignition tube and an infrared spectrum recorded from a film of the collected pyrolysis condensates that had been placed on a potassium bromide plate. The solvent used to extract each sample is given at the end of the secondary heading. For example, AEP = acetone extracted pyrolysate; other abbreviations are given on page xi.

Where the material was judged to be sufficiently pure (e.g., base rubber polymers or uncompounded plastics), pyrolysate infrared spectra could be recorded without the need for the initial extraction step. These instances are described in their respective secondary headings as pyrolysate as received (PAR).

### Single bounce ATR spectra

A Nicolet infrared spectrometer has been used to record all of the spectra in this book and the spectra in this specific section were recorded using a Nicolet 'Golden Gate' single bounce ATR accessory fitted to a Nicolet 360 FTIR instrument.

### **Company names and tradenames**

As mentioned previously, for a large number of the materials it has been possible to provide information on their origin tradename and manufacturer. However, for a number of reasons information of this sort can date very quickly and it will be apparent that the names of some of the manufacturers are no longer current.

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