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Raman imaging for deformulating a transdermal patch

Chemical sciences

Introduction

Renishaw's RA802 Pharmaceutical Analyser was used to deformulate an over-the-counter nicotine transdermal patch. Deformulation is the separation and identification of multiple individual components in a formulated product. This technique helps you compare and understand similar - perhaps competitive - products and then develop alternative or more effective formulations.

The RA802 Pharmaceutical Analyser is a benchtop chemical imaging system providing:

- High specificity, enabling resolution of multiple components (including polymorphic and amorphous forms) to be resolved
- Identification of unknown components
- High spatial resolution and sensitivity, so even low concentration components can be detected
- Analysis with minimal sample preparation and through transparent / translucent packaging

Figure 1.The Renishaw RA802 Pharmaceutical Analyser

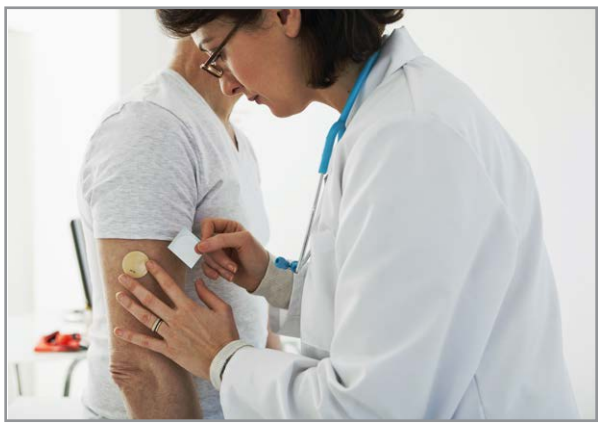

Figure 2. Transdermal patches are widely used to provide a sustained dose over a long period of time

One measurement to identify multiple components

The protective film was removed from a nicotine patch. It was then placed on one of the dedicated magnetic stage plates, adhesive-side up, in the RA802.

The RA802 Raman Analyser's StreamLine™ fast imaging technology and LiveTrack™ autofocusing was used to analyse a scan of a 7.50 mm by 4.96 mm area that was performed using a 20 µm step size. The scan took 50 minutes to complete. The LiveTrack technology maintained focus for optimum Raman data collection over the large analysed area.

Renishaw's WiRE software, specifically the Empty Modelling component analysis and spectrum search, was used to identify unknown components of the sample (Figure 4). Empty Modelling produces concentration images and component spectra from a scanned map without needing prior information on the contents of the sample.

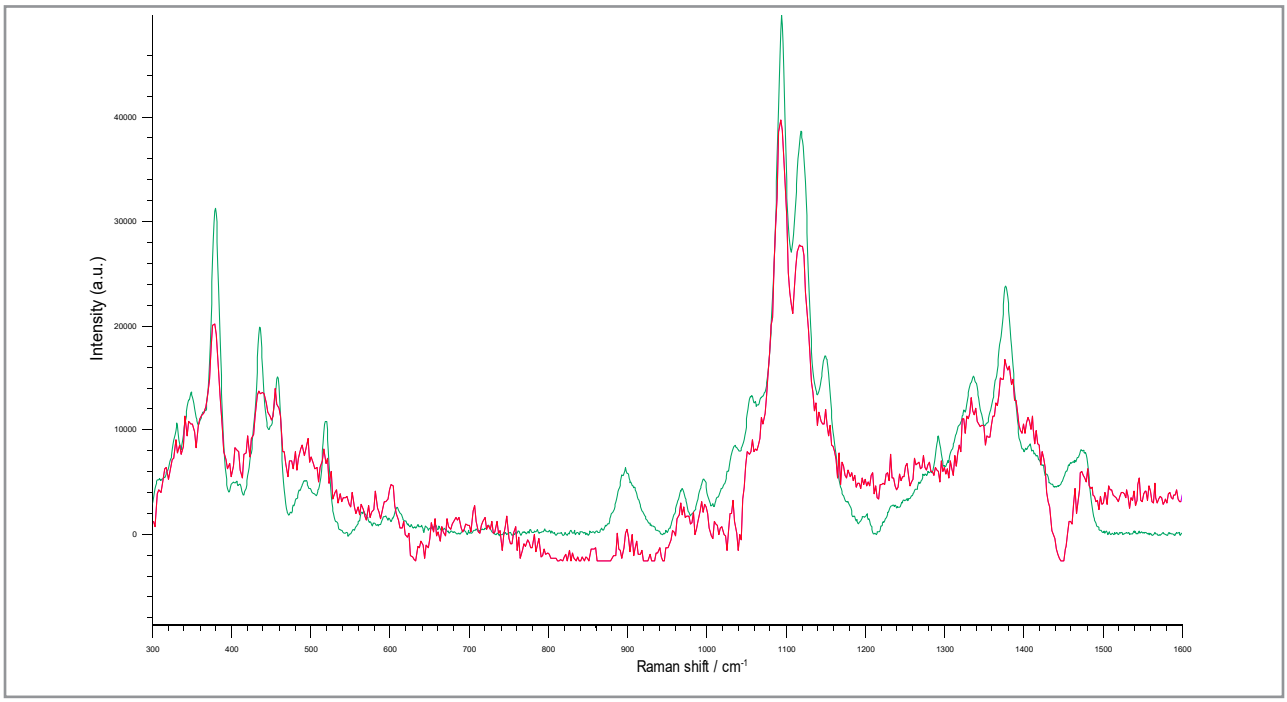

Figure 4. Identifying formulation components using Spectrum Search in Renishaw's WiRE software - an Empty Modelling component spectrum (red), resolved from the map measurement of the nicotine patch, matches to a library spectrum of microcrystalline cellulose (green)

The unknown materials in the patch were identified as nicotine, an ethylene vinyl acetate-based (EVA-based) matrix material and microcrystalline cellulose (MCC). The Empty Modelling images (Figure 5) reveal a nonuniform distribution of nicotine, correlating to the EVA matrix distribution. Interestingly, MCC was found to form fibrous patterns within the patch matrix. The inclusion of this ingredient is a patented aspect of some transdermal delivery patches. MCC causes the polymer to swell in contact with water, which increases delivery to the skin when the patch is applied.

Empty Modelling enables both Raman and fluorescence spectral information to be extracted from a mixture and chemical images of the scanned area to be generated. These reveal the presence of an additional fluorescent material with a fibrous network within the patch in addition to the other components (Figure 5b).

Renishaw plc

Spectroscopy Products Division
New Mills, Wotton-under-Edge,
Gloucestershire GL12 8JR
United Kingdom

T +44 (0) 1453 524524
F +44 (0) 1453 524901
E raman@renishaw.com

www.renishaw.com/raman

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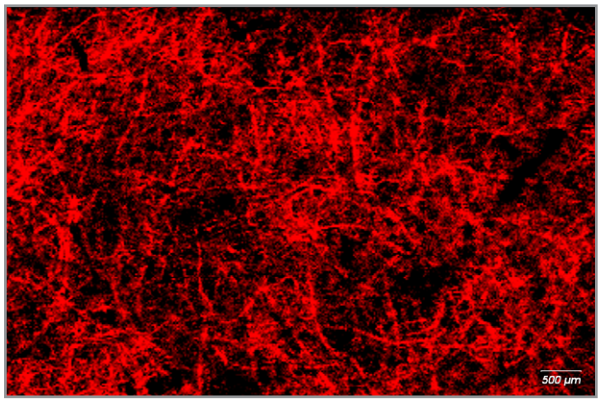

Figure 5a. Image of microcrystalline cellulose distributed, with a fibrous structure, within the patch matrix

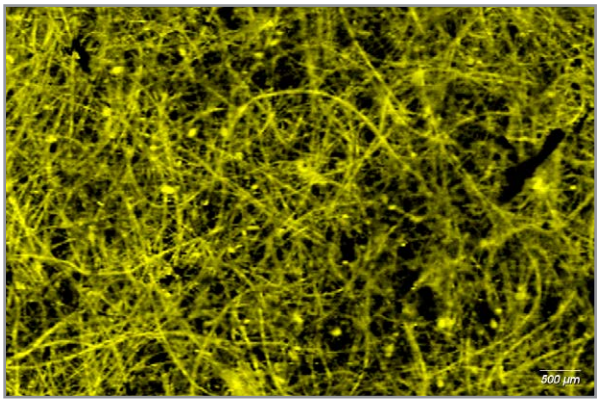

Figure 5b. Image of fluorescent fibres within the patch matrix

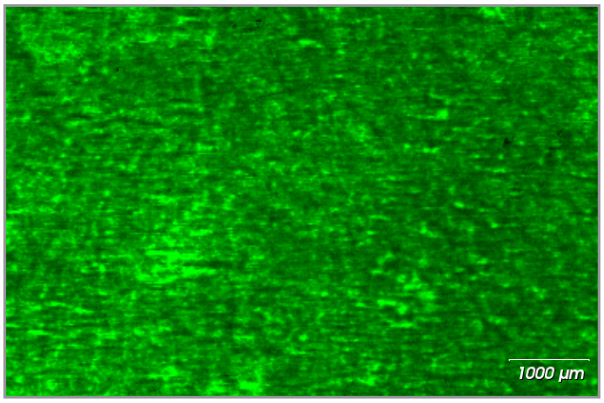

Figure 5c. Image of nicotine and the EVA-based matrix material, distributed together. Variations in the intensity of green correlate to differences in the uniformity of these materials

Conclusion

The information on composition and distribution of components all came from one measurement with the RA802. No sample preparation was required. Gaining an understanding of complex, multicomponent formulations like this nicotine patch enables formulators to refine their design, improve the delivery of their products and gain a competitive advantage.

Renishaw. The Raman innovators

Renishaw manufactures a wide range of high performance optical spectroscopy products, including confocal Raman microscopes with high speed chemical imaging technology, dedicated Raman analysers, interfaces for scanning electron and atomic force microscopes, solid state lasers for spectroscopy and state-of-the-art cooled CCD detectors.

Offering the highest levels of performance, sensitivity and reliability across a diverse range of fields and applications, the instruments are designed to meet your needs, so you can tackle even the most challenging analytical problems with confidence.

A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Please visit www.renishaw.com/ra802 for more information.