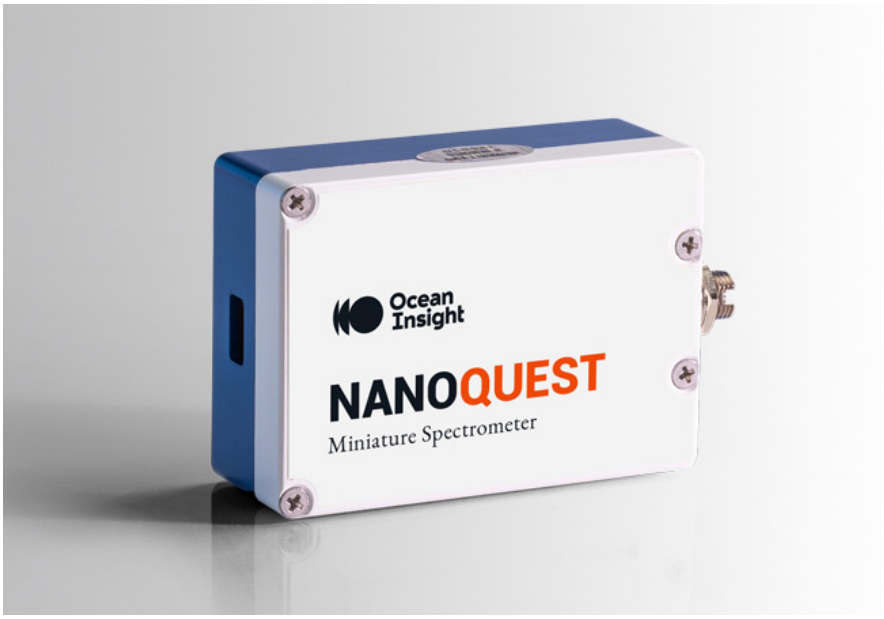
Identifying Textiles with Extended-range NIR Spectroscopy



A compact, MEMS-based, single-photodetector NIR device, the NanoQuest, is used to distinguish different types of textiles.

Application Note

KEYWORDS

- FT-IR spectroscopy
- Textiles (natural and synthetic)
- MEMS-based devices

TECHNIQUES

- Reflectance

APPLICATIONS

- Textiles identification
- Materials characterization

Introduction

NIR spectroscopy offers a simple tool to identify different types of textiles, with distinct spectral features observed at wavelengths >1350 nm. This approach may be useful for authentication of natural and synthetic consumer textile products.

Experimental Conditions

Reflectance from 100% cotton, nylon and satin textile samples was measured across the extended NIR wavelength range (1350-2500 nm) using the Ocean Insight NanoQuest spectral sensor with a high-powered tungsten halogen light source (Ocean Insight model HL-2000-HP) and 600 µm Visible-NIR reflection probe. Measurements were made with the probe oriented at 90 degrees relative to the fabric surface using a

manual optical stage. All measurements were referenced to a WS-1 model PTFE (Teflon) diffuse reflection standard.

NanoQuest is based on Fourier transform infrared (FT-IR) technology. Its patented micro-electro-mechanical systems (MEMS) technology allows for a continuous-wave Michelson interferometer to be created monolithically on a MEMS chip, enabling detection of all wavelengths simultaneously across the 1350-2500 nm range.

In the NanoQuest software, optical resolution was set to 8 nm (FWHM) and a custom gain setting was generated to optimize the signal to noise ratio for the measurement setup. Each sample was measured at 5 different locations with resulting spectral data pretreated by a 2nd derivative with smoothing, and a standard normal variate (SNV) was applied. Principal component analysis (PCA) was applied to the dataset.

Results

The NIR spectra measured with the NanoQuest can easily discriminate among the different textile types. **Figure 1** shows the reflectance spectra of the three textiles measured: cotton, nylon, and satin. Differences in the spectral profile for each sample can be seen readily, and the inset PCA plot shows distinct separation between the clusters for each textile sample.

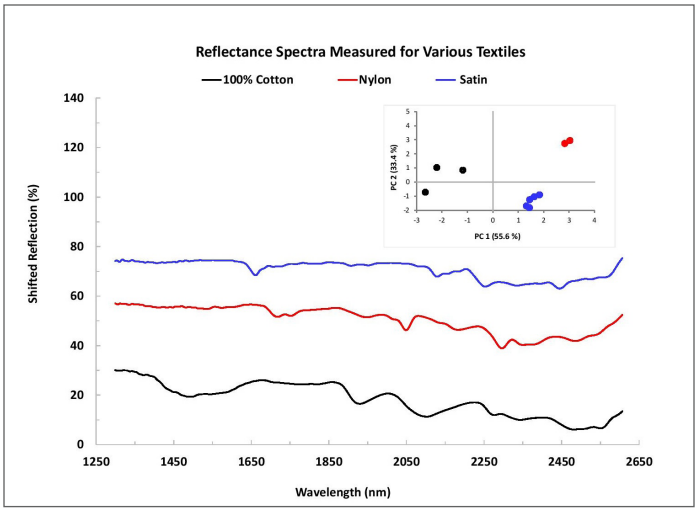


Figure 1: Comparison of the three textile samples measured with NIR reflectance. The inset PCA scatter plot shows results after pretreatment by 2nd derivative and SNV.

Conclusions

The experiments clearly demonstrate that the NIR spectra measured with the NanoQuest exhibit unique features helpful to identify both natural and synthetic textiles. Application of PCA to the spectra further demonstrated the distinction among textile samples. Additional tests may include testing unknown textile samples to correctly identify them.

Additional NanoQuest application areas include authentication (polymer identification), food and agriculture (soil analysis and soybean screening), and biomedical (bodily fluids analysis).

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