Abstract

Non-destructive and rapid identification of fabric fibres using near infrared spectroscopy

H. Yuan,[a,*] R. Chang,[a] L. Tian[b] and X. Li[a]

[a]*College of Material Science and Engineering, Beijing Univ. of Chemical Technology, Beijing 100029 China*

[b]*Beijing Textile Fibre Inspection Institute, Beijing 100025 China*

Introduction

A fast quality inspection technique is very important to process quality control for fabric fibre or textile production, and to routine quality inspection for textile commodities in the market. Being a large producing country of fabric fibres and textile products, China attaches importance to develop efficient fibre identification methods. The test methods for identification of textile fibres currently used include: sensory, burning, optical microscopy, scanning electronc microscopy, DNA chip, Infrared (IR) and near-infrared (NIR) spectroscopy. Among these methods, NIR spectroscopy has the best potential by virtue of its merits of fast and easy manipulation *in situ* or on-line. Many applications of NIR spectral analysis in the textile industry have been published. Most of them have concentrated on quality control of yarn slivers and greige (un-dyed) fabrics in production, rather than the more difficult application to dyed or printed fabrics. This paper describes a feasibility study of quick identification of fabric fibres using NIR spectroscopy.

Materials and methods

A total of 214 fabric fibre samples were collected from Beijing textile fibre inspection institutes in China. They included various textile fibres of polyurethane, silk, polyester, cotton-polyester blends, polyamide, cotton, flax, cotton-flax blends, viscose fibre, wool, cashmere, and wool-cashmere blends. The samples were representative of real fabrics. Spectral data were collected in the reflectance mode from the range of 10000 cm^{-1} to 4000 cm^{-1} at 4 cm^{-1} resolution. Each spectrum of a sample was the average of 64 replicate spectra. Classification of 12 kinds of fabric fibres in various structure patterns was studied, using the minimum spanning tree method, and SIMCA classification based on principal component analysis. All calculation programs were written using MATLAB code and run in MATLAB 7.4.0.

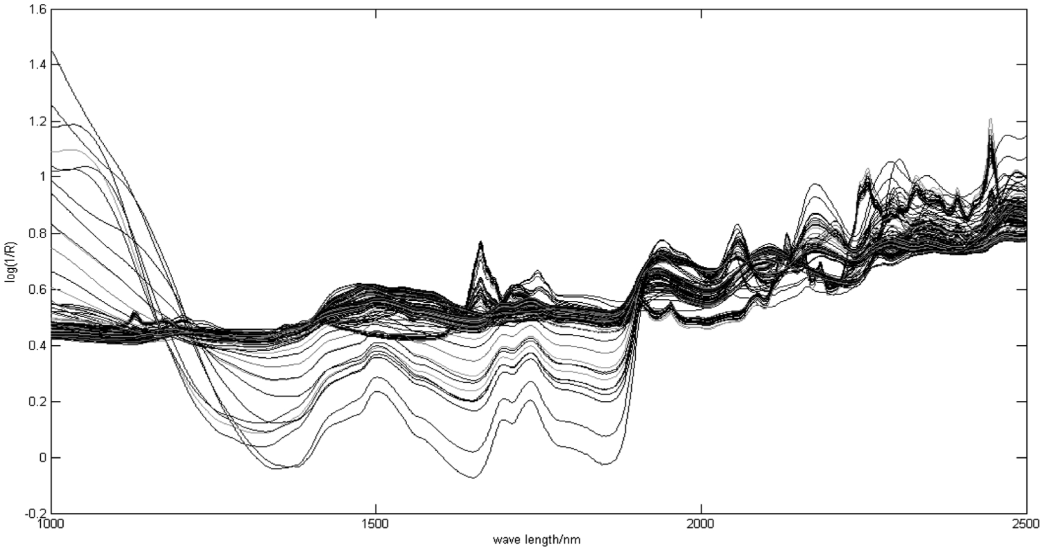

Figure 1. MSC-treated spectra of total fibre samples.

Results and discussion

The noise and baseline shift of spectra are reduced by MSC. The large variance (Figure 1) in absorbance of total samples implies that discrimination of different types of fabric fibres by near infrared spectral information is possible.

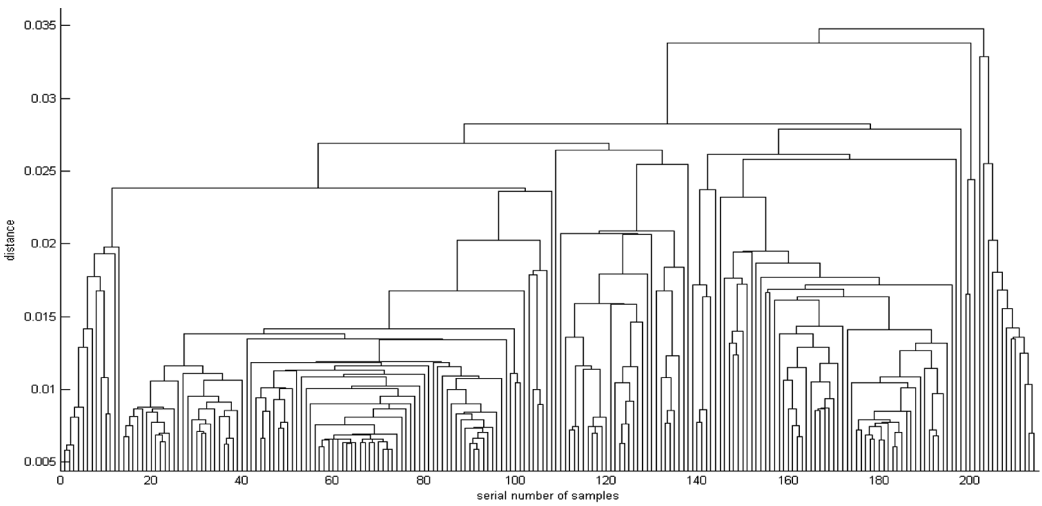

Figure 2. Minimum spanning tree plot of total samples using PC.s as eigenvector.

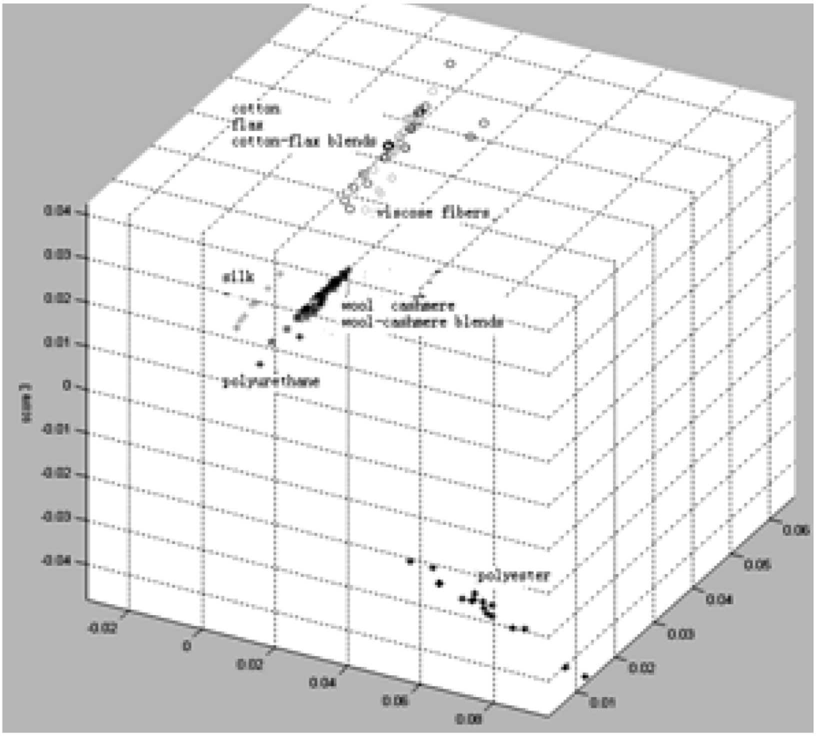

Figure 3. Distribution of total samples in spanning space of PC1-3.

The minimum spanning tree (Figure 2) shows that each type of fibre samples can cluster together, and there are overlaps among different type clusters.

Different fibre types with largely different chemical compositions are easily discriminated in PCs space from total samples (Figure 3).

However, heavy overlaps occurred among different kinds of fibres with similar chemical compositions. A complete discrimination among different kinds of fibre with similar chemical compositions was achieved using SIMCA.

It can be concluded that non-destructive and rapid identification of fabric fibres using NIR spectroscopy is potentially feasible.