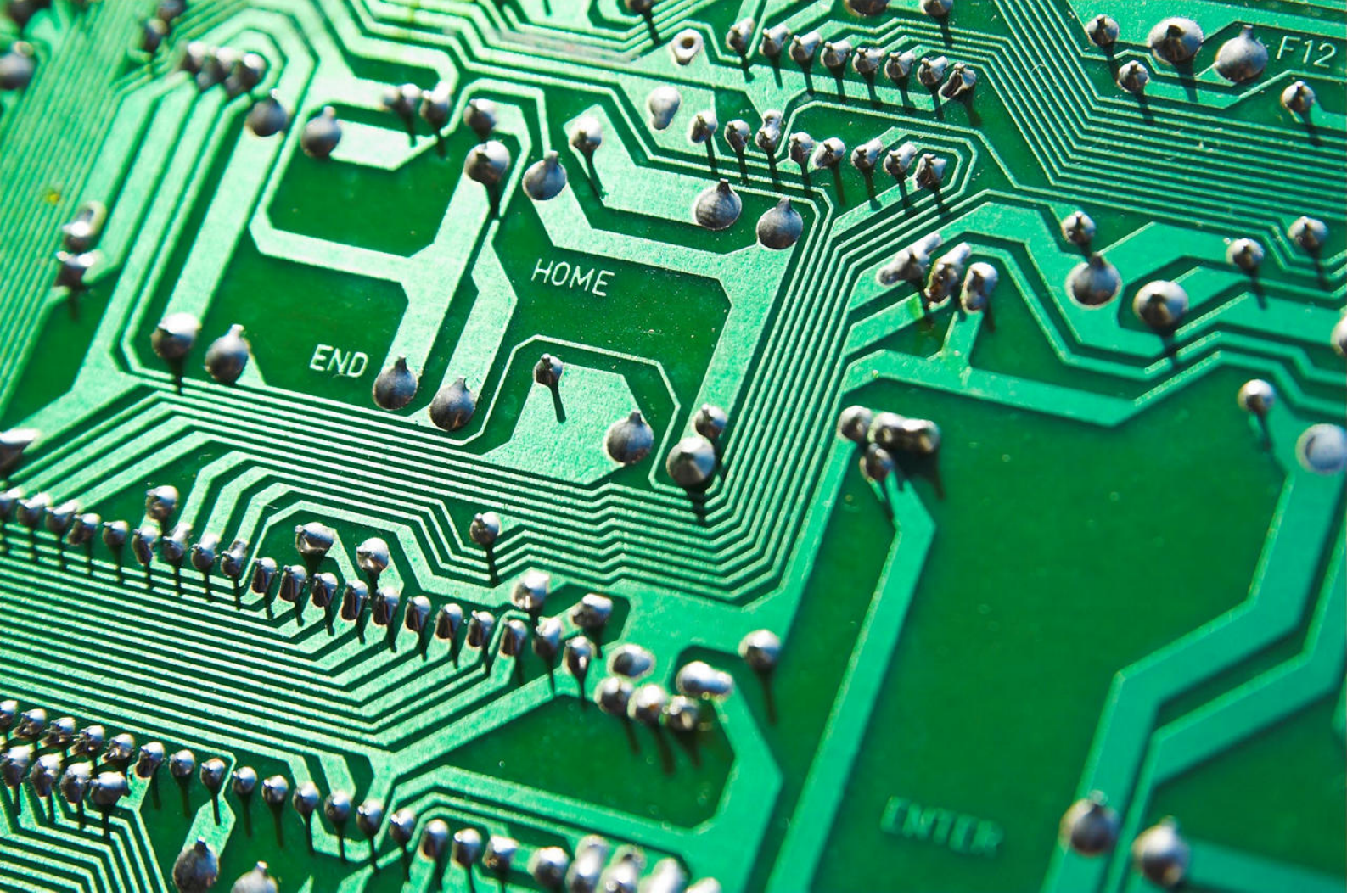

Application Note AN-NIR-089

Quality Control of Laminates

Improved PCB production testing with NIR spectroscopy

In the semiconductor industry, thermoset resins combined with fabric or paper are used as an intermediate layer between substrates of printed circuit boards (PCB). These polymer-based sheets (laminates) are chosen depending on thickness and their thermomechanical and electrical characteristics. Important quality parameters are tensile and shear strength, the glass transition temperature, expansion coefficient, and dielectric constant.

Near infrared spectroscopy (NIRS) is a fast, non-destructive and easy-to-use analytical method which allows the measurement of multiple parameters in less than a minute. The following Application Note describes the determination of the transition time of PCB laminates by NIRS, a parameter correlating with the thickness, glass transition temperature, and tensile strength of the material.

EXPERIMENTAL EQUIPMENT

520 spectra of samples were collected using a Metrohm DS2500 Solid Analyzer and the Vision Air Complete spectroscopy software. The laboratory values for the transition time were determined by melting the samples, and values between 60 and 126 seconds were obtained. The data set consisting of spectra and lab values was split into a calibration and validation set (1:1). Outlier detection was performed on pre-processed spectra (2nd derivative and SNV) using a maximum distance algorithm. The NIR prediction model was created with the equipment described in Table 1 and validated using the validation set.

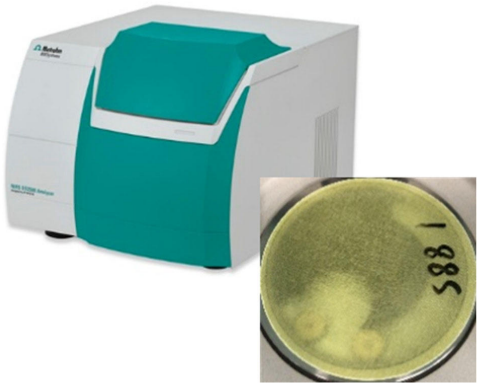

Figure 1. DS2500 Solid Analyzer and a polymer sheet resin.

Table 1. Hardware and software equipment overview

Equipment	Metrohm number
DS2500 Solid Analyzer	2.922.0010
DS2500 large sample cup	6.7402.050
Vision Air 2.0 Complete	6.6072.208

RESULTS

The obtained correlation graph displays a high correlation (R^2 = 0.95) between transition times predicted by NIR and the primary lab method (Figure 3). The validity of the prediction model is confirmed by the figures of merit (Ratio SEC to SECV < 20%), confirming that NIR spectroscopy is a suitable analytical method to determine transition times of PCB laminates.

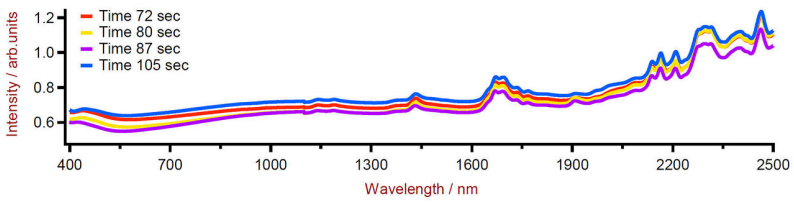

Figure 2. Vis-NIR spectra of polymer resins measured on a DS2500 Solid Analyzer.

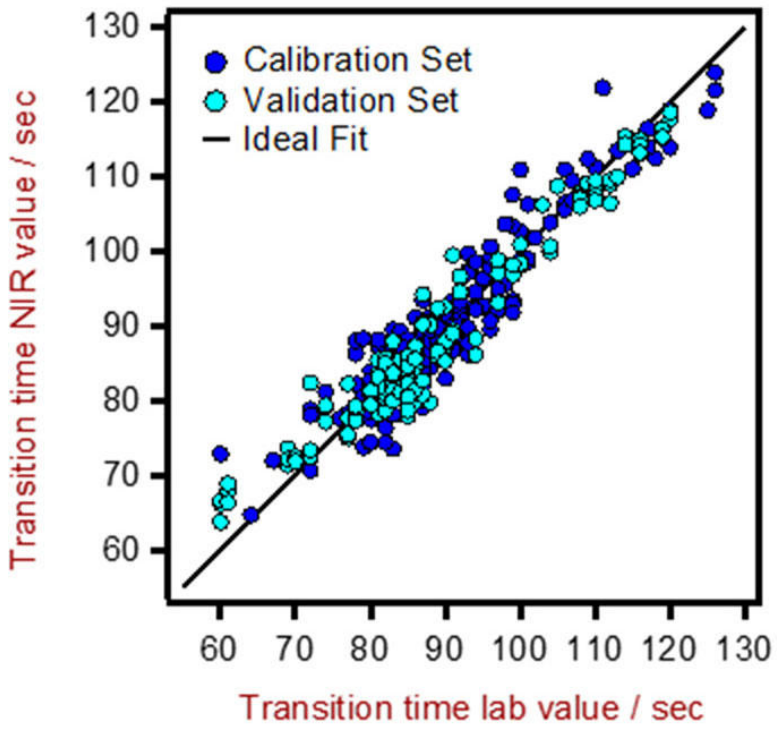

Figure 3. Correlation diagram for the prediction of transition times using a DS2500 Solid Analyzer.

Table 2. Figures of merit for the prediction of transition times using a DS2500 Solid Analyzer.

Figures of merit	Value
R^2	0.95
Standard error of calibration	3.64 s
Standard error of cross-validation	4.02 s

CONCLUSION

This application note demonstrates the feasibility of the DS2500 Solid Analyzer for the determination of transition times of polymer resins. Vis-NIR spectroscopy enables a fast determination without any sample preparation and therefore represents a suitable tool to check the transition kinetics of PCB laminates.

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