

Application Note AN-NIR-089

# Quality Control of Laminates

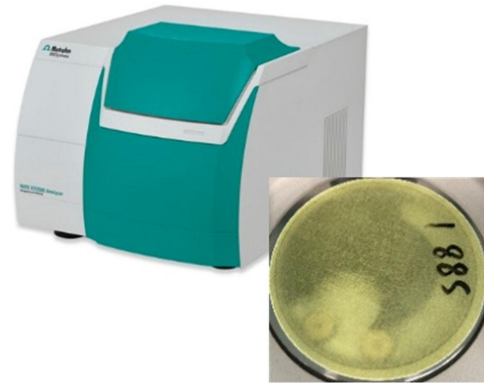
## Improved PCB production testing with NIR spectroscopy

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 (2<sup>nd</sup> 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.

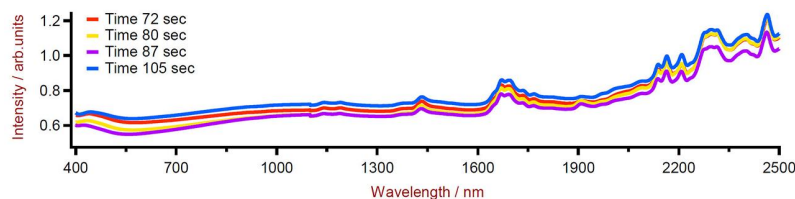
**Table 1.** Hardware and software equipment overview

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

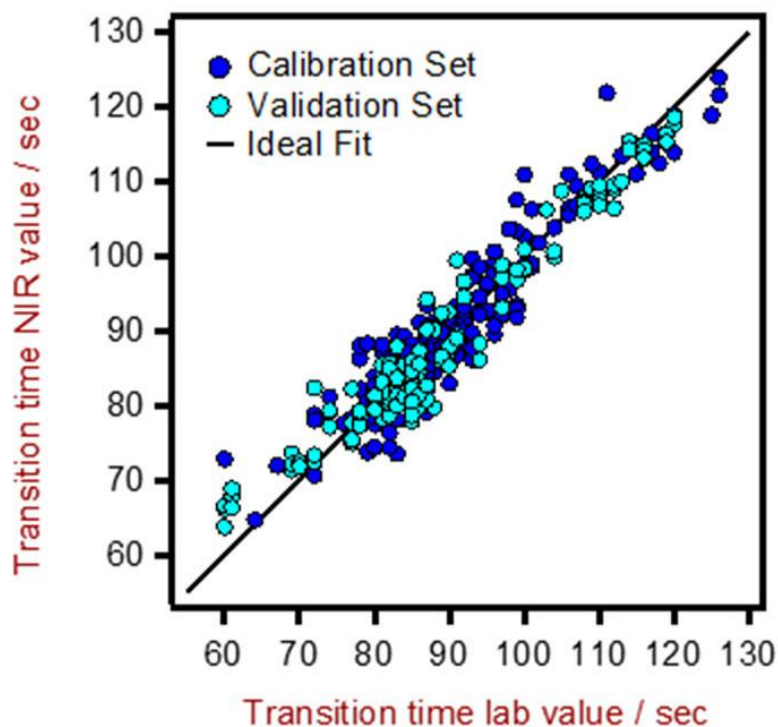
## RESULTS

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.

## CONTACT

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### DS2500 Solid Analyzer

**固耐用的近外光,用于生境和室中的量。**

DS2500 分析是活解决方案,用于整个生程中的固体、乳膏和液体行常分析。其固耐用的使 DS2500 Analyzer 分析不受灰、湿度、振和温度波影,因此非常用于在劣的生境中使用。

DS2500 涵盖了从 400 到 2500 nm 的整个光范,并能在不到一分内提供准和可再的果。DS2500 Analyzer 足制行的要求,并由于操作便而能助用完成其日常工作任。

由于与完美匹配,附件可以承受任何具有挑性的品型,例如:粒料之的粗粒固体或乳膏之的半固体品,可得最佳果。量固体的候,使用 MultiSample Cup 可以提高生率,可以自批量最多 9 个品。



### DS2500

用于在不同品位置使用 NIRS DS2500 Analyzer 采集粉末和粒反射光的大号品容器。



## Vision Air 2.0 Complete

### Vision Air – 通用的光分析件。

Vision Air Complete 是用于管范境的先易用的件解决方案。

Vision Air 点一:

- 独特的件用和配的用界面保了直的操作方式
- 操作程的建与方式
- SQL 数据,可安全且地管理数据

Vision Air Complete (66072208) 版本包含所有用于可近外光分析量保程的用:

- 器和数据管理用
- 方法用
- 常分析用

其它 Vision Air Complete 解决方案:

- 66072207 (Vision Air Network Complete)
- 66072209 (Vision Air Pharma Complete)
- 66072210 (Vision Air Pharma Network Complete)