Application Note 410000029

See-through ID with Raman technology

Through-package identification with 1064 nm Raman

Raman spectroscopy is widely used for rapid, nondestructive identification in scientific, medical, and law enforcement settings. Traditionally, it is used to sample materials directly or through transparent/translucent barriers, which limits its practicality in the field. A new and unique advancement—Raman identification through opaque packaging—overcomes this limitation. Through-package analysis permits easier, safer, and faster material identification and avoids contact with unknown substances for warehouse inspections, first responders, and customs agents.

See-through Raman spectroscopy (ST) is a recently developed technology that expands the capability of Raman spectroscopy to measure samples through packaging materials. The technology is available on the Metrohm TacticID-1064ST (TID1064ST) handheld Raman system with 1064 nm laser excitation. This design enhances the relative intensity of the signal from deeper layers, increasing the effective sampling depth and permitting measurement of materials inside visually opaque containers.

ST technology also incorporates a large sampling area. The larger sampling area has the additional advantages of preventing sample damage through reduced power density and improving measurement accuracy of heterogeneous materials.

ST AND COMMON CONTAINERS

Through-package identification of materials in white polyethylene (PE) bottles (a common packaging for solid chemicals) and other opaque packaging such as white and manila envelopes is demonstrated with 1064 nm Raman spectroscopy. The container contribution is removed with advanced identification algorithms, and the sample is correctly identified. Identification through colored plastic, multiple opaque layers, and thick glass can be made with TID1064ST. Identification of sodium benzoate inside a white PE bottle is given in Figure 1.

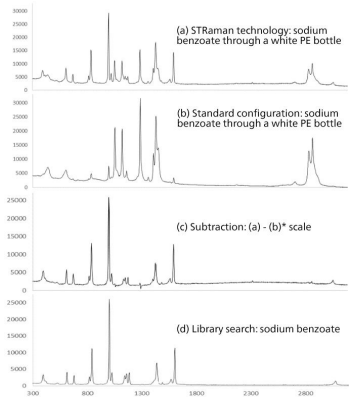

Figure 1. ST identification of sodium benzoate through a white polyethylene bottle: (a) ST scan, (b) standard Raman scan, (c) subtraction: (a) - (b)* scale, and (d) library sodium benzoate spectrum.

Coated tablets can also be identified. ST technology penetrates the coating layer and measures the Raman spectrum of the underlying tablet. This allows the instrument to effectively sample through colored and dark materials, enabling reliable analysis without being obscured by surface effects. Figure 2 shows the Raman spectrum of a tablet with a very dark coating. Despite interference from the coating, signature peaks are still apparent.

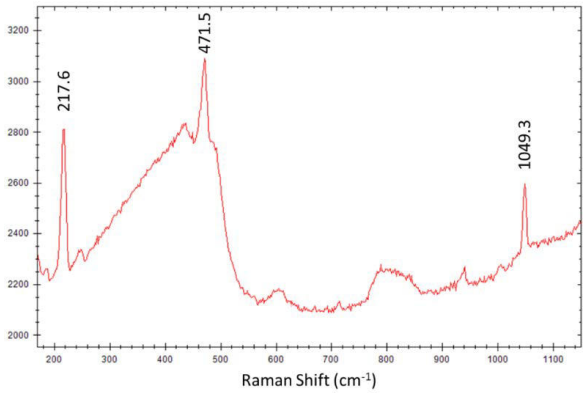

Figure 2. Example of a 1064ST spectrum of a tablet with very dark coating.

APPLICATIONS OF ST TECHNOLOGY

Many raw materials are packaged in single- or multi-layer kraft paper sacks, often with a plastic lining. Brown kraft paper exhibits strong fluorescence under 785 nm Raman excitation, which can hinder material identification. However, with ST and 1064 nm Raman technologies, accurate identification is possible even through such challenging packaging.

To demonstrate, we evaluated the ability of ST Raman at 1064 nm to identify several common excipients—varying in Raman scattering strength—through multi-layer paper bags used in pharmaceutical raw material packaging. As shown in Table 1, even trisodium phosphate, a notoriously low Raman scatterer, was correctly identified. A positive ID requires a hit quality index (HQI) above 85 that exceeds the second-best hit by at least 2 points. In contrast, trisodium phosphate could be identified only through white kraft paper using 785 nm excitation.

Figure 3 shows the spectrum of trisodium phosphate as measured through a two-ply bag of white and brown kraft paper, with a positive library search result. Although the spectrum is dominated by spectral features from the paper bag, TID1064ST is capable of reliably identifying trisodium phosphate.

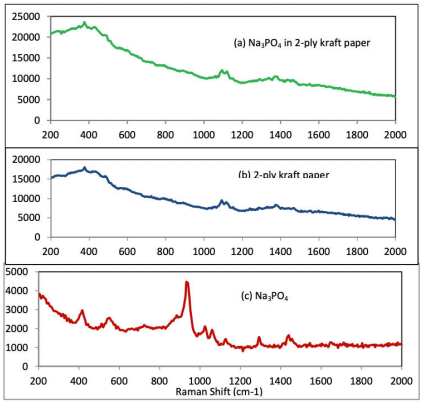

Figure 3. Identification of trisodium phosphate in bilayer bag of white and brown kraft paper layers: (a) ST technology, (b) standard Raman configuration, and (c) pure spectrum of trisodium phosphate.

Table 1. Positive identification of samples in kraft paper bags using 1064 nm ST technology.

Packaging material and # layers	Calcium carbonate ($CaCO_3$)	Dextrin	Cyclodextrin	d-Maltose H_2O	Trisodium phosphate (Na_3PO_4)
1 white kraft + 1 brown kraft	97.7	96.7	95.6	93.8	93.2
2 layers of brown kraft	97.6	92.2	91.6	90.9	88.7
2 layers of white paper	96.8	98.025	95.2	95.0	94.9
1 white kraft paper with blue bands + 1 brown kraft paper	95.1	92.8	91.4	91.35	89.0
1 white paper + 1 woven fiber	96.2	95.7	93.2	92.6	91.1
1 white kraft + 1 plastic film + 1 brown kraft	96.1	91.8	92.0	90.7	88.4
1 white kraft + 2 brown kraft	97.4	94.6	94.0	92.9	93.0

CONCLUSION

The ability to measure samples inside packages, eliminating the need for sample contact, is one of the major advantages of Raman spectroscopy. Metrohm's ST technology permits measurements through opaque materials: from white plastic bottles to fiber and kraft paper sacks, envelopes, and even skin. This supports easy adoption of this spectroscopic tool in many working environments, from the laboratory to the field. The combination of ST technology and 1064 nm laser excitation addresses even dark and highly colored packaging materials. This makes Raman suitable for many new potential users, for whom it has not previously been a viable tool.

CONTACT

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CONFIGURATION

TacticID-1064 ST Basic

TacticID®-1064 ST は、爆発物、麻薬、ならひにその他の疑わしい物質を現場にて迅速に識別するための 1064nm のハントヘルトラマンアナライサーてす。TacticID-1064 ST の透視機能により、不透明および透明な梱包を通してサンフルを非破壊て分析てき、ファーストレスホンター、セキュリティスタッフ、捜査当局、爆弾処理班、税関や国境警備局、ならひに危険物処理班かサンフルとの接触を最小限に抑えて機敏に対応てきるように、サンフルの脅威レヘルかはっきりと表示されます。

TacticID-1064 ST は、特許を取得した STRaman® テクノロシーと組み合わせた、実績のあるラマン分光法を使用しており、ユーサーは不明な化学薬品、麻薬、医薬品、爆発物、および他の多くの物質を、不透明な遮断物の上からてもリアルタイムて識別を実行し、作業の不確実性と反応時間を大幅に低減することかてきます。

1064nm レーサー励起および透視用途のための ST アタフター付き TacticID-1064 ST は、広いサンフルエリアをスキャンし、蛍光フリーのスヘクトルを生成し、ユーサーは困難なストリートサンフル、不均一な混合物を識別、ならひに梱包を通して物質を直接識別てきるようになります。

この IP68 規格準拠のシステムの特徴は、保護具越しても扱いやすいタッチスクリーンおよひ/またはハートウェアホタンインターフェースを備えた高輝度ティスフレイにあります。

Metrohm TacticID-1064ST Basic ハッケーシには、シースルーアタッチメント、汎用アタッチメント、ホリスチレンアタッチメント、耐久性の高いキャリーケース、ケーフル、電源、レーサー保護メカネか含まれます。

TacticID-1064 ST Advanced

TacticID®-1064 ST は、爆発物、麻薬、ならひにその他の疑わしい物質を現場にて迅速に識別するための 1064nm のハントヘルトラマンアナライサーてす。TacticID-1064 ST の透視機能により、不透明および透明な梱包を通してサンフルを非破壊て分析てき、ファーストレスホンター、セキュリティスタッフ、捜査当局、爆弾処理班、税関や国境警備局、ならひに危険物処理班かサンフルとの接触を最小限に抑えて機敏に対応てきるように、サンフルの脅威レヘルかはっきりと表示されます。

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Metrohm TacticID-1064ST Advanced ハッケーシには、シースルーアタッチメント、汎用アタッチメント、SWD アタッチメント、ハイアルホルター、LWD アタッチメント、ライトアンクルアタッチメント、ホリスチレンアタッチメント、浸漬フローフ、頑丈なキャリーケース、ケーフル、電源、レーサー保護メカネか含まれます。