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Short Communication

Analysis of Liquid Specimen in a Glass Ampoule by 532 nm Laser Micro-FT-Raman

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Abstract: Micro FT-Raman spectroscopy was applied to examine the contents in a glass ampoule non-destructively. Water, linger solution, ethanol and nail color remover liquid were examined. Glass was sufficiently thin enough to obtain Raman spectrum from the contents in the ampoule. All the examined materials showed the fine Raman profiles. The results indicated that micro-FT-Raman has a potential to examine and check the contents and impurities in the ampoule non-destructively.

Key Words: Micro FT-Raman, Glass ampoule, Liquid, Alcohol, Acetone

Introduction

Glass ampoule is widely used for clinical trials under taken care of the guidance such as the Center for Drug Evaluation and Research (CDER), and/or the Center for Biologistics Evaluation and Research (CBER) (1). These medical use ampoules are very carefully manufactured, but in rare cases they contained impurities such as fragments of glasses, metals, insects, etc. Some efforts are taken to understand and not only qualify but also quantify the impurities in drugs and medicines (2). To analyze the content of glass ampoule in intact is a matter of challenge and some fine-art techniques are introduced (3). Among many non-destructive analytical methods, micro FT-IR spectroscopic method is one of the most popular methods for the ease of handle of specimen and instrument as well as analytical cost. However, FT-IR analysis of liquid specimen requires some special expensive attachments and techniques. FT-Raman had a great improvement in the last decay, and has an extreme potential to analyze the materials in any phases including solid, gasses and liquid. Micro-Raman is a conventional analytical instrument which is equipped with a microscope and able to analyze pointed regions with a few mm sizes. In this study, a micro-FT-Raman spectroscopy was applied to detect the content in a glass ampoule.

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Materials and Methods

Materials

A standard brownish glass ampoule was used as a container of the tested liquids: pure water, pure ethanol and nail color remover (Bersante Co. Ltd.). The glass ampoules was filled with each liquid and examined using a micro-FT-Raman described below.

Micro FT-Raman Spectroscopy

Micro FT-Raman study was carried out using a RXN system, Kaiser Optical Systems Inc., USA, equipped with an OLYMPUS BX51 TRF microscope. Micro-Raman spectra were acquired with a Kaiser RXN1 Fourier transform Raman (FT Raman) spectrometer. The green laser source was a NewPort INVICTUS operated at 532 nm. An iDUS, ANDOR Technology, thermoelectric cooled CCD was used for detection. Rayleigh line rejection was accomplished with a HoloPlex transmissive grading, Kaiser and spectra for this work were acquired over the range of 100-4400-cm^{-1} Raman shift. All Raman spectra were acquired as at 2.5 cm^{-1} resolution. Data acquisition was carried under the conditions of the accumulation time: 2 sec. and the accumulation number: 2. To reduce fluorescence arising from the glass ampoule (brown cylindrical, ~18-mm o.d.), the laser was focused 1-2 mm inside the ampoule.

Results

Fig. 1 showed the micro FT-Raman spectra of the glass of the

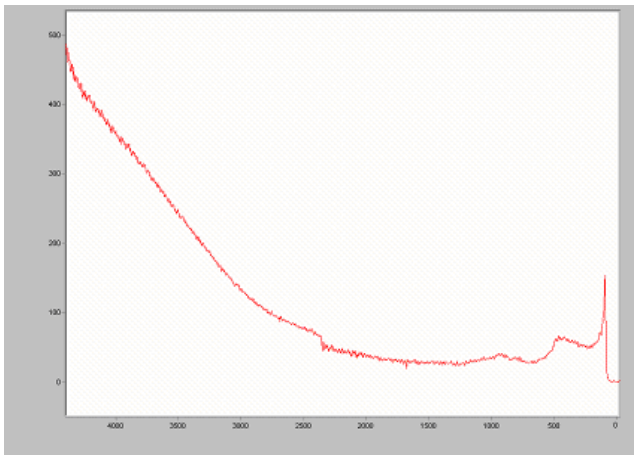

Fig.1. Micro FT-Raman spectra of the ampoule glass tube.

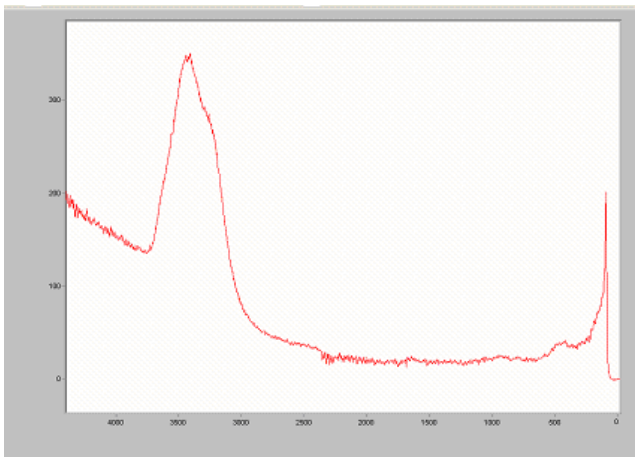

Fig. 2. Micro FT-Raman spectra of water in the ampoule.

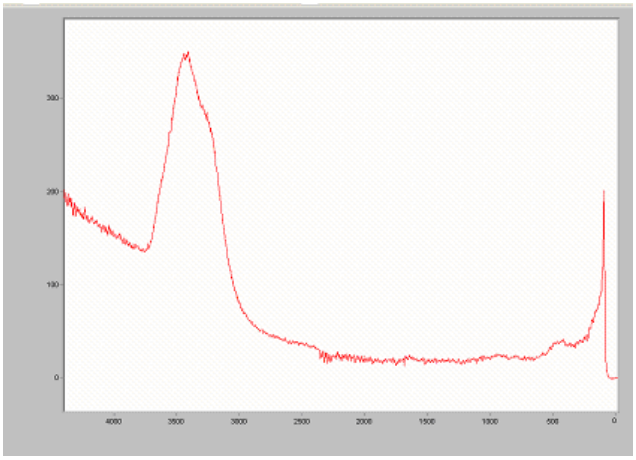

Fig. 3. Micro FT-Raman spectra of linger liquid in the ampoule.

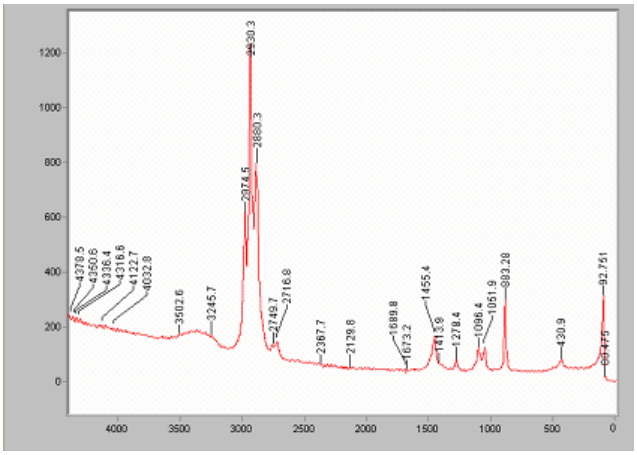

Fig. 4. Micro FT-Raman spectra of ethanol in the ampoule.

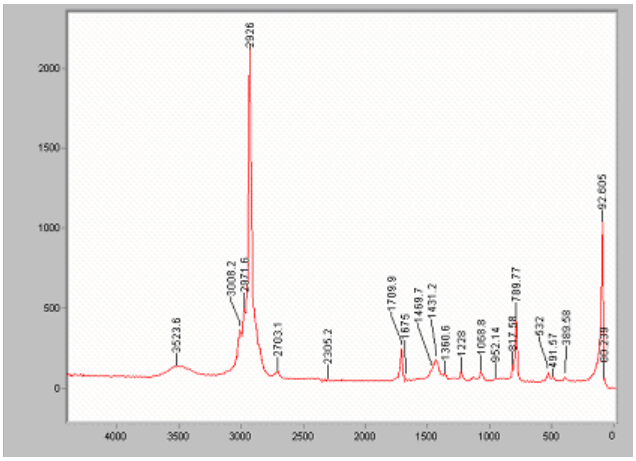

Fig. 5. Micro FT-Raman spectra of nail-remover liquid in the ampoule.

ampoule. As expected, FT-Raman spectra of the glass did not show any significant Raman shift in the range between 100 cm^{-1} and 4400 cm^{-1}. Two types of glass ampoule were tested by the micro FT-Raman: one made of transparent glass ampoule and the other made of brown colored gall ampoule. There was no significant difference between them in Raman spectra.

Fig. 2 showed the micro FT-Raman spectra of water in the ampoule. There was no significant peak but a strong broad peak at around 3000-3500 cm^{-1} due to water molecules.

Fig. 3 showed the micro FT-Raman spectra of Linger solution in the ampoule. The spectra of Linger solution was almost the same to that of water.

Fig. 4 and Fig. 5 showed the micro FT-Raman spectra of ethanol and nail color remover liquid in the ampoule respectively. The Raman peaks of ethanol and the nail color remover were clearly differentiated from each other as listed in Table 1 together with the ethanol (4) and acetone (5) data.

Discussion

This study showed that FT-Raman spectroscopic analysis is a powerful tool for examination of contents in a glass ampoule. The glass did not affect the obtained Raman spectra in peak shift and intensity. The two examined organic solvents were clearly differentiated. The tested ethanol (C_2H_6O) showed identical Raman peaks to the reference data (4). The nail color remover used in this study contained acetone (C_3H_6O), water (H_2O), polyethylene glycol (HO-(CH_2-CH_2-O)$_n$-H (PEG-12)), isopropanol or isopropyl

Table 1. Three strong Raman peaks were marked by **BOLD** type.

Water	Ethanol	Nail remover	Ethanol (ref. lingj23864)	Acetone (ref. Acetone)
cm-1	cm-1	cm-1	cm-1	
3500-3000	3500-3200	3524		
		3008		3006
	2975	2972		2968
	2930	**2926**	2931	2924
	2880			2848
	2749			
	2717	2703		2698
		2305		
		1710		1710
	1455	1431	1453	1428
	1414			
		1361		1356
	1278		1274	
		1228		1222
	1096		1097	
	1052	1069	1051	1066
	883		883	
		790		788
		532		530
		492		
	431		431	
		390		394

alcohol ($CH_3CH(OH)CH_3$), campher ($C_{10}H_{16}O$), some perfumes and others, including aloe extract. The Raman spectra obtained for the nail color remover was identified with acetone in majorty as shown in Table 1.

Raman spectrometry is, as well as FT-IR, able not only to identify components but also to quantify the amount of each component, although they are in minor content. Micro FT-Raman has many advantages over micro FT-IR such as a pin-point detection as small as 1 mm in size. However, there are several problems to be sold, e.g., self-fluorescence from organic matters which rise background and disappear the essential peaks.

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