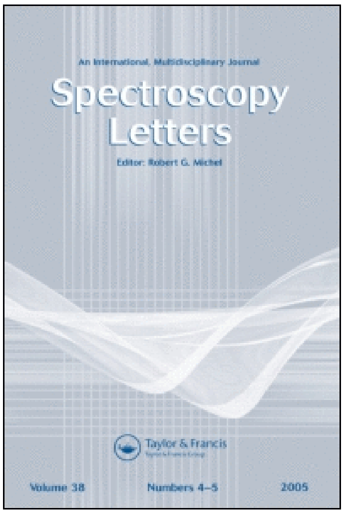

Spectroscopy Letters
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713597299

Modification of Cary 14H Spectrophotometer into a Fiberoptic Absorption Spectrophotometer

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To cite this Article Dai, S. , Cul, G. D. Del , Metcalf, D. and Toth, L. M.(1994) 'Modification of Cary 14H Spectrophotometer into a Fiberoptic Absorption Spectrophotometer', Spectroscopy Letters, 27: 5, 687 — 690
To link to this Article: DOI: 10.1080/00387019408000862
URL: http://dx.doi.org/10.1080/00387019408000862

SPECTROSCOPY LETTERS, 27(5), 687-690 (1994)

MODIFICATION OF CARY 14H SPECTROPHOTOMETER INTO A FIBEROPTIC ABSORPTION SPECTROPHOTOMETER

Key Words: Fiberoptic instrumentation, UV-visible spectroscopy, Near-IR spectroscopy.

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ABSTRACT

An efficient fiberoptic interface system was developed to convert a Cary 14 H spectrophotometer into a fiberoptic instrument. This new spectrophotometer can be used to study the UV-visible and near-IR absorption spectroscopy of radioactive samples and wastes in a confined environment.

INTRODUCTION

The development of fiberoptic spectroscopic instrumentation as a spectroscopic technique has greatly facilitated the study of otherwise intractable samples.[1-5] In particular, in-line spectroscopic monitoring of chemical processes can be carried out by this technique. In an effort to provide a fiberoptic UV- visible and near-IR(NIR) spectrometer for routine measurement of radioactive samples and wastes in a confined environment, we have developed a simple fiberoptic interface for our Cary-14 scanning spectrophotometer .

EXPERIMENTAL DETAILS AND DISCUSSIONS

The Cary-14 spectrophotometer converted by On-Line Instrument Systems(OLIS) for data acquisition and analysis by an IBM-AT personal computer was used for all measurements. The

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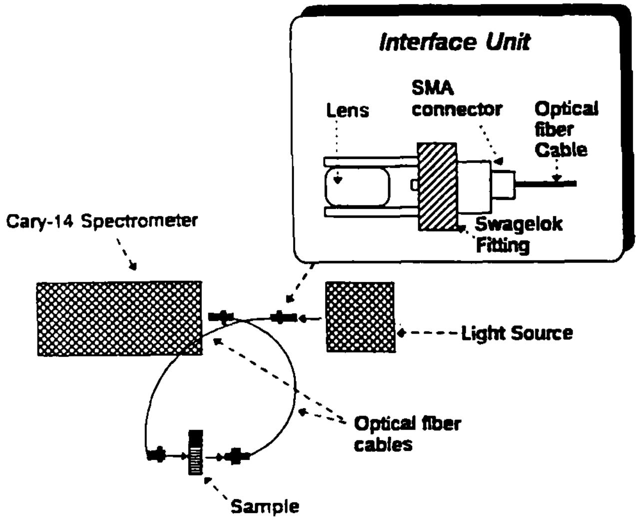

Figure 1. Fiberoptic interface system.

detector in the NIR wavelength range consists of PbS , while a PMT detector is employed in the UV-visible range. The light source is either a tungsten halogen lamp for visible and NIR or a deuterium lamp for UV. These light sources are chopped at a certain frequency to remove the interfer ence from the room light. This instrument is modified for use with a bifurcated fiberoptic system. The schematic diagram of this modifiation is shown in Figure 1. Basically, the whole fiberoptic interface system consists of two main parts: a fiberoptic excitation system and a fiberoptic signal collection system . The light from the spectrometer was focused into a 200 μm optical fiber with a fiber-light coupling unit in the fiberoptic excitation system. The detailed drawing of this coupling unit is shown in the insert of Figure 1. It consists of a quartz lens(9.85 mm dia X 10 mm long; focal length=15 mm) mounted in #316 stainless steel reducer. This reducer is compatible with compression type fitting and fitted with SMA stainless short bushing 1/4-36 thread for fiberoptic cable at the one end. This coupling unit is commercially available from Atlantic Industrial Optics, Inc.(5 Cedar Creek Ave., Georgetown, DE 19947) at the cost of about $100. The other end of the optical fiber was interfaced with another such coupling unit. The collimated light from this end is passed through the sample unit and the transmitted signals are collected by the fiberoptic collection system. The fiberoptic collection system has the exact same configuration as that of the excitation. Therefore, the whole fiberoptic modification system can be assembled for less than $500.

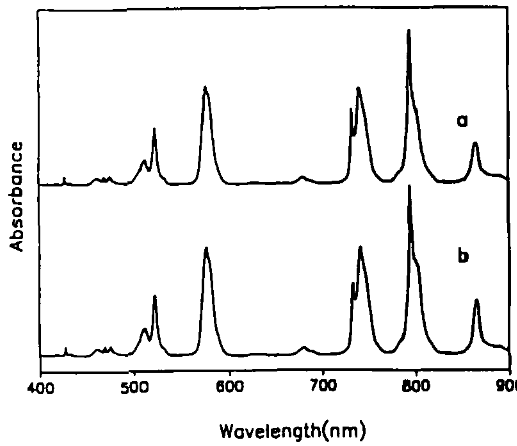

Figure 2. Visible and near-IR absorption spectra of a aqueous solution containing $Nd(NO_3)_3$: (a) recorded by the conventional method; (b) recorded by the fiberoptic system.

The measurement of visible and NIR spectra of an aqueous solution containing $Nd(NO_3)_3$(1. M) was chosen to demonstrate the capability of this fiberoptic system. Figure 2b gives a typical spectrum of such a solution recorded by this fiberoptic system, while the spectrum of the same solution measured by the conventional method is shown in Figure 2a. The two spectra are virtually superimposable and compare well with those given in the literature.[6] Unlike those recorded by the fiberoptic spectroscopic system of Brown et al,[5] no deformation was found in the spectra measured by our system. The absorption bands of the $Nd(NO_3)$ aqueous solutions in this range are originated from the weak f-f electronic forbidden transitions. The successful detection of these relative weak and sharp peaks further illustrates the applicability of the present technique and the high resolution capability.

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Date Received: January 21, 1994
Date Accepted: March 4, 1994