



# High Performance Diode Laser Enables Low-Cost Raman Spectroscopy

**A narrow linewidth, wavelength stabilized diode laser has been developed for low-cost Raman spectroscopy applications.**

**R**aman spectroscopy, which is an ideal tool for qualitative and quantitative chemical analysis, has been limited from widespread use due to its high instrumentation cost, especially in its excitation source. The CLEANLAZE™ series narrow linewidth diode lasers developed recently by B&W TEK, Inc. provide a low-cost, yet high performance solution, which, for the first time, makes high resolution Raman spectroscopy affordable in price.

## Introduction

The core part of this laser is a high-power broad-stripe laser diode with its output spectrum narrowed and stabilized using a novel cavity technology. Conventional external cavity lasers are both delicate and high in maintenance cost due to the inclusion of external reflective dispersive elements resulting in a long cavity length. While in the CLEANLAZE™ laser, the wavelength selective element is an integral part of the laser diode through hybrid integration process. As a result, the laser is both ultra compact in footprint (only 4 mm x 4 mm x 3 mm including the wavelength selective element) and stable to environmental change (such as temperature, vibration, and humidity variation). The utilization of broad-stripe laser diode guarantees the low cost of the whole module and at the same time, it can provide much higher output power (up to 1.5 W) than its DFB and DBR counterparts. The wavelength selective element filters out unwanted spectral sidelobes from the broad-stripe laser diode and locks its output wavelength to the filter's central wavelength. With this innovative cavity technology and optimized proprietary manufacturing process, the spectral linewidth of the laser can reach  $0.8 \text{ cm}^{-1}$  (i.e. 0.05 nm) at 785 nm and the temperature sensitivity of the central wavelength is as low as  $0.01 \text{ nm}/^\circ\text{C}$ . This low temperature sensitivity makes it possible for Raman excitation without using thermal electric cooler (TEC), thus enables low power consumption operation for portable Raman instrumentation. Other features of this laser include fiber coupled output,  $-35^\circ\text{C}$  to  $50^\circ\text{C}$  operating temperature range and a long life time of  $>10,000 \text{ h}$ .

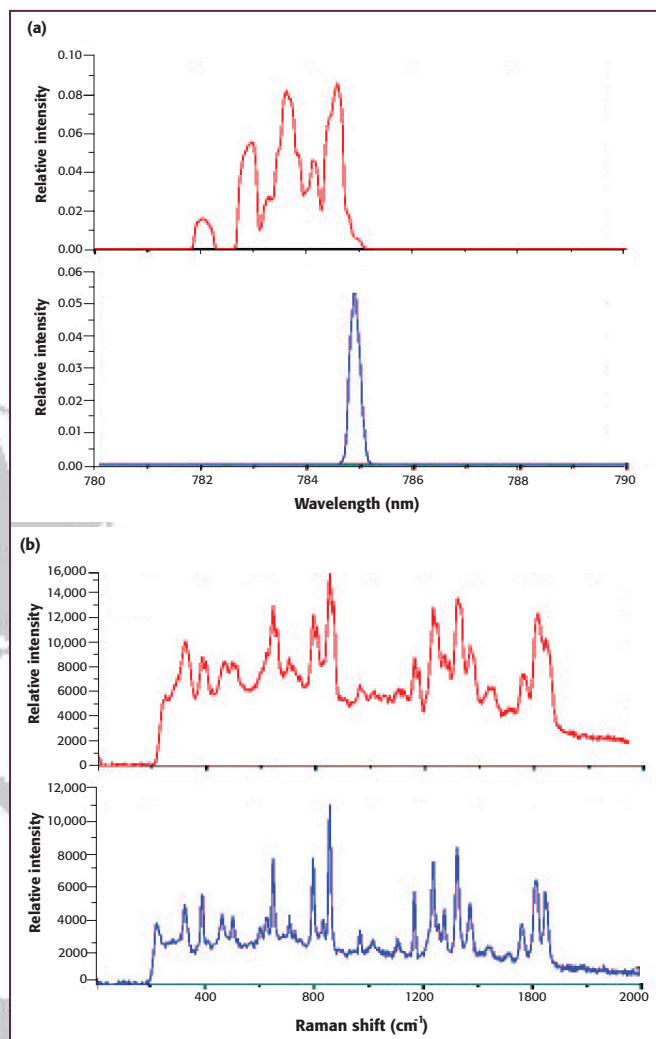
## Experimental Results

An example of the high performance of the CLEANLAZE™ laser is shown in Figure 1, in which the output spectrum of a regular broad-stripe diode laser and a CLEANLAZE™ laser and the Raman spectrum of a Tylenol™ sample excited by the two lasers are compared. It can be clearly seen that the CLEANLAZE™ laser generated Raman spectrum provides much better resolution.

## Conclusions

The CLEANLAZE™ diode lasers offer a high performance and

Daniel Lombardi, Sean Wang, and Qun Li  
B&W Tek, Inc.



**Figure 1.** (a) Comparison of the output spectrum of a regular broad-stripe diode laser (upper) and a CLEANLAZE™ diode laser (lower); (b) Comparison of Raman spectrum of a Tylenol™ sample excited with the regular broad-stripe diode laser (upper) and the CLEANLAZE™ diode laser (lower).

low-cost solution to high resolution Raman spectroscopy and pave the way for wide deployment of this technique.

**B&W Tek, Inc.**

825 Dawson Drive, Suite 1, Newark, DE 19713  
Tel. (302) 368-7824, Fax (302) 368-7830  
info@bwtek.com, www.bwtek.com