Bringing hands-on education to STEM with Omni-Cell

In this note: We explore some examples of physical and chemical concepts that can be demonstrated in high-schools and universities with easy-to-use and accessible equipment such as the Omni-Cell.

Introduction

"By doing" is the best way of learning. It is even more important in STEM degrees, where an experience is never forgotten by the person actively experimenting on it, compared with reading about it from a book. Learning from what others did before us is key ("standing on the shoulders of giants" is a common motto), but the more one can personally experience, the better. However, schools and universities are also looking to provide these experiences on a limited budget: products such as the Omni-Cell are perfect for this. By focusing on a reusable and easy-to-use solution, the Omni-Cell makes accessible the "rediscovery" of plenty of concepts throughout all learning steps: from school to undergraduates (without forgetting that it is used daily in current state-of-the-art R&D! [1]). This is our effort to highlight the importance of experimenting, always with the "safety-first" principle, in this case, during the learning process for kids, teenagers, and young adults.

The Omni-Cell™ is a modular system for transmission analysis of liquids and mulls.

- Quick and simple for many analyses
- Convenient modular construction
- Pathlengths from 25-1000 µm
- Extensive range of window options
- 3x2 slide mounts to any spectrometer

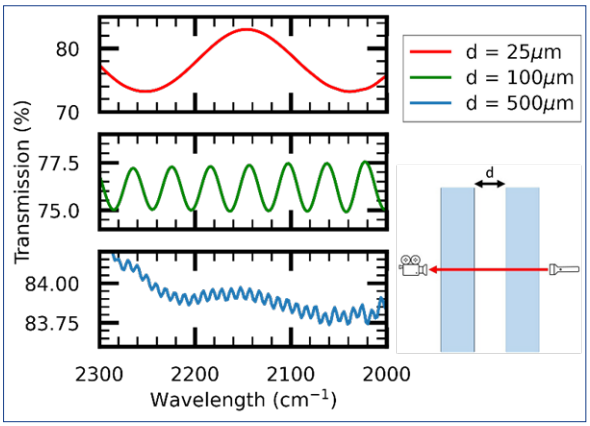

Figure 1: Interferences in light.

Experimental examples and discussion

We will highlight three concepts which, in greater or lesser detail, are taught in high-school and undergraduate studies:

1. Interferences in light:

The creation of constructive and destructive interferences is a key concept in every lecture concerning the behaviour of light as a wave. And a typical example of this fact is the presence of interference fringes through two parallel windows separated some distance (schematic on the right side of Figure 1). For more information about the topic, we recommend visiting the Application Note referenced here [2]. But experimentally speaking, it is noteworthy the difference between the light transmitted spectra through different parallel window pathlengths (or distance between the windows) when compared between each other. As shown in Figure 1, the distance between appearing peaks in the interference varies with the distance between these windows. Every measurement presented here takes seconds, being a good way of internalizing the concept of interferences, from a show & tell interactive perspective.

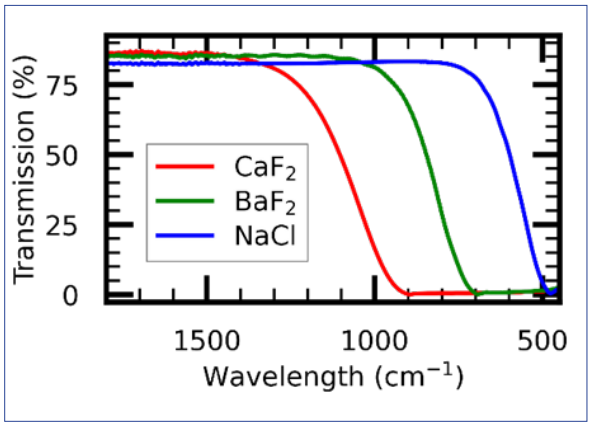

Figure 2: Interferences in light.

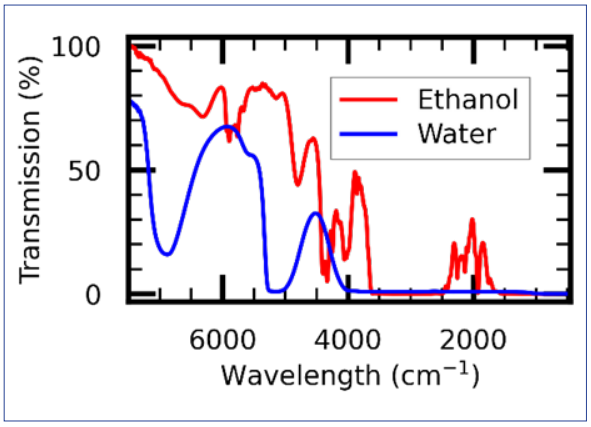

Figure 3: Spectroscopic fingerprints

2. Fundamentals of spectroscopy:

Spectroscopic techniques are found in our day-to-day lives to a degree we don't even think about, and it sounds generally more complex than it is. Spectroscopy, fundamentally, just studies how light changes after interacting with the object to be studied. Just knowing about the initial light that is used and the resulting light after going through an object gives such valuable information about that object, that spectroscopy is used constantly in research, metrology, and industry, among others. In this case, using the Omni-Cell, concepts such as absorption, transmission, or the importance of "taking a background" can be easily presented in a way anyone can absorb why they are relevant. Reducing the "fear" of complex concepts is the first step to mastering them. In our Application Note [3], we discuss further about transmission and absorption concepts, which we recommend looking into. But for a quick experiment using Omni-Cells (Figure 2), using different window materials, how absorption works, its dependence on the material the light goes through, or general spectroscopic concepts can be shown and be played with.

3. Spectroscopic fingerprints:

A step forward from the last point is going deeper into the understanding of why peaks appear where they appear. What is an absorption band, why the transmittance goes to zero, or why some peaks are where they are is a discussion that is so much enhanced by a live demonstration. For example, using our Omni-Cell with different conventional liquids (such as water or ethanol), molecular bonds (C – O, H – O, …) allows their vibrations to be discussed, seen, and understood via their spectroscopic fingerprints. We recommend looking at our Application Note [4] for more information about how to interpret a spectrum, where these fingerprints are discussed in more detail. But in the meantime, measuring and seeing them in person (Figure 3) brings closer concepts that look so complex.

Conclusions

These simple, 15-minute experiments that can be done during a lecture can root down concepts for years. The strong conceptual foundation they create shapes every aspect of future education in anyone that experiences them. Products like the Omni-Cell help in this process. We want to give our little bit of help towards this effort. Not only with products such as the Omni-Cell, but being present during the process, helping educators achieve this goal. We invite high schools and undergrad groups to contact us, to come to our facilities to facilitate this interaction, or even setting up an in-house visit to your location to pursue these hands-on experiences.

References

[1] AN20-03	[2] AN18-04	[3] TN21-04	[4] TA00-00

Contact us today

Reach out to us any time for more information on the application described in the text above or visit our website **specac.com** to read more and make an enquiry.

United Kingdom
sales@specac.co.uk
+44 (0) 1689 892 902

United States
sales@specac.com
+1 866 726 1126

China
frank.li@specac.com

Singapore
kamhar.woo@specac.co.uk