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BE AWARE Research Area

CUBITO (Containment Utility Bin Through Insertion and Tucking Operations) , is a 3D printed cube-like prototype made of interlocking pieces. The purpose of this prototype is to be used for farming operations, such as gardening pots. In a near future, these pieces will be made of recycled PET bottles, so CUBITO will have the benefit of being eco-friendly.

Motivation or Background

There are many ways to nondestructively inspect food quality now a days, such as x-ray, ultraviolet (UV), visible, fluorescence, Raman, infrared, and terahertz. Raman scattering effect was first experimentally served by Indian physicists C.V. Raman and K.S. Krishnan in 1928. Since its discovery, Raman spectroscopy has come a long way to become one of today's advanced sensing techniques. The obstacles, such as weak scattering signal, strong fluorescence interference, low detection efficiency, and slow data processing, had prevented the Raman technique from being broadly and routinely used for many years. Though technology has improved Raman Images lasers and camera lenses for better detecting food impurities in powders. Raman Images consists in scanning food samples with a laser that reflects lights into a camera and projects certain peaks into a graph. The highest peak in the graph is the Raman peak the represents that specific food powder.

Objectives

- Identify the Raman Peaks of different food powders such as fructose, lactose and other sugars, titanium dioxide, chili powder, milk powder, flour and other food powder and chemicals.
- Prove that Raman technology can identify when a contaminant is mixed with one the food powders.

Methodology

To identify the Raman peaks of different food powders and chemicals, 25 mm width x 25mm height x 1mm depth plates were used to carefully place the food powder or chemical that was to be studied. The plate must be completely full of the substance and filled up to the 1mm mark. The plate was then placed in the Raman Imaging Machine and was scanned for 5 minutes, producing then the Raman Peak for the substance.

For proving that the Raman Machine could identify contaminants in the food powders, 30 grams of the food powder was placed in a container with 0.1508grams of the contaminant. The container was then placed on a Resodyn Acoustic Mixer at 100% intensity and 61.9% frequency was left for 10 minutes for the mixture to be completely homogeneous. The mixture was then placed on a 50mm width x 100mm height x 1mm deep and prepared exactly as the food powder samples were prepared. They were then placed on the Raman Machine and scanned for 30 minutes. The Raman Machine then produced a graph that presented where the contaminant was in the sample.

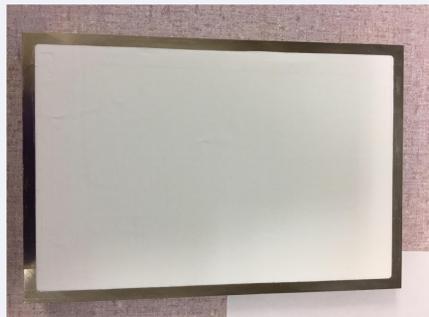


Fig. 1
Mixture Sample prepared for scanning in the Raman Machine



Fig. 2
Resodyn Acoustic Mixer with mixture sample

Results

The Raman peaks for every chemical and food powder was successfully completed. Based on these Raman peaks, we chose which contaminants to place with which food powders, for if the contaminants and the food powder had the same Raman peak, the Raman Machine wouldn't be able to detect one from the other. Using Microsoft Excel, we were able to graph most of the contaminants together to observe their different peaks.

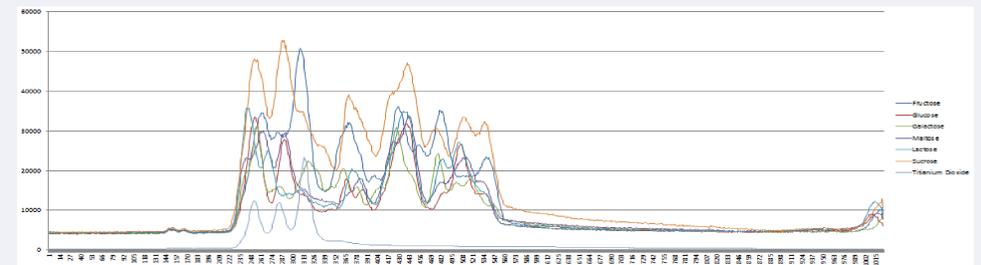


Fig. 3 Raman Peaks of Different Contaminants such as Fructose and Titanium Dioxide

After scanning the mixtures, they were analyzed using a program called Envy 4.5 that showed the spectral profile of the mixture. If the mixture showed too much fluorescence, an algorithm in Matlab was used to correct the Raman Image and to see better the Raman peaks.

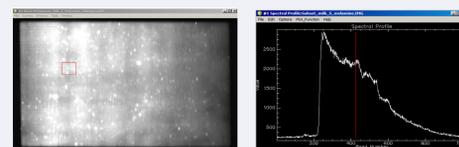


Fig. 4 Fluorescence before Matlab Algorithm correction

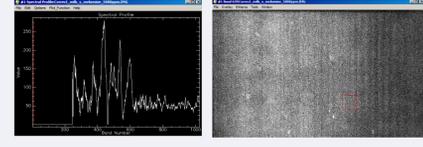


Fig. 5 Raman peak after fluorescence correction

Skills and Experience

Being my first internship experience, I got to see what it was to go to work everyday in the morning and leave in the afternoon. It was a great experience for me since I plan to be in the working fields soon what is to report to my mentor and ask what would be the work for the day. This internship was a great feeling of what my future life would be soon.

What I Learned

As an Industrial Engineer major, Raman Imaging was not familiar to me. I was taught everything from the basics of Raman Images, to how the machine works, to how to prepare the samples and the different types of Raman Images there are. Going to work everyday was also a great learning experience. It helps us undergraduate students have a taste of what the working fields will be like in a near future.

Future Plans

I will graduate in May 2018 and I plan to work in a private company such as Walt Disney, General Motors or Boeing. For that I have to finish my 5th year at the University of Puerto Rico Mayaguez Campus and revalidate as an Industrial Engineering.

Acknowledgments

I would like to thank Prof. Mauricio Cabrera for guiding me throughout my research and for informing me about this internship. Also Dr. Krystel Castillo for providing me the opportunity to be in this internship and Qin Jianwei for being my mentor during this internship.

Financial assistance from the U.S. Department of Agriculture/National Institute of Food and Agriculture (Award Number: 2015-38422-24064) is gratefully acknowledged.

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