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Design of an Optical Sensor System for the Detection of Mold Contamination Based on its Auto-Fluorescence Property.

ABSTRACT - Masterthesis

Mold is a general term describing a wide variety of fungi. Spoilage of books and food is a common problem generated by mold. Humans suffer various health effects like allergy and asthma when exposed to high concentrations of mold. With little moisture and at adequate temperature, mold comes to existence easily and grows faster. Molds have tolerance or can survive under tough environmental condition. Hence, a sensor setup is designed for quantifying the molds present in the environment. Early detection of mold is important for prevention of spoilage of food and books. With the physical property of auto-fluorescence in some species of airborne fungus spore, a measurement setup is proposed to quantify and characterize the fungus spore. The proposed sensor system is a rapid, non-invasive method by using intrinsic properties of mold for its detection.

Luminescence, composed of fluorescence and phosphorescence, is a light emitted from any substance due to the transition of the electron from its excited state to the ground state. Auto-fluorescence is an intrinsic property of bio-cells which efficiently replaces the visual inspection of the staining process in micro-organisms for fluorescence detection. Auto-fluorescence is generated by the inherent fluorophores in the living cells like Tryptophan, NAD (P) Hand Riboflavin to name a few. Once excited with the light, depending on the chemical structure or composition of the biological sample, light is absorbed by the fluorophore and re-emitted photons are generated at a specific wavelength. With less effort in sample preparation, auto-fluorescence being a natural phenomenon, this principle serves as a good indicator for monitoring the presence of microbes in the environment.

The purpose of this thesis is to implement a mobile fluorescence detection system composed of UV-LED module, optical assembly and amplified photodetector. Meanwhile, an optical spectrometer and CMOS image camera are used as an auxiliary tool for mold characterization. The optical assembly is designed to guide the excited light from the UV-LED precisely onto the sample. Once excited with UV light, the emitted light is detected using photodiode. In summary, the tasks of the work are listed as below:

1. Design a fluorescence detection system

2. Optimization of the optical assembly to enhance the resolving power or power efficiency.

3. Characterization of the fungi spore concentration.