

Abstract

In an effort to gain more information from vertical burn tests and improve the efficiency with which they are performed, a motorized apparatus with an attached microscope was engineered to maintain view of a sample at all times despite movement while burning. Using image processing in Mathematica combined with LabVIEW programming, linear translation stages moved the sample in response to images attained in real-time from the microscope. Thus, the sample always remained in view of the microscope as well as an X-ray beam despite a small field of view and the possibility of sample contortion. This tracking method will be used in the future to study not only flame retardants, but the charging of lithium ion batteries and the anatomy of laboratory mice.



Figure 1: Battery sample with intersecting lines depicting the miniscule 3 mm² field of view



Figure 2: Actual microscope image capture of battery shown in **Figure 1**

Introduction

Problems with the UL-94 Standard for Analyzing Samples

- No indication of chemical data that determines whether a sample is an adequate flame retardant • No high-resolution imaging
- possible
- Small field of view with microscope and X-ray (Figure 1 and 2)
- Ring clamp does not prevent contortion of sample (**Figure 3**)



Figure 3: Flame retardant sample beginning to warp under heat

Objective

Engineer a machine with the capability of tracking moving samples and attaining chemical data from them efficiently despite an extremely small field of view





The Original SolidWorks Design (above)

Mathematica

time images and ascertain sample position

LabVIEW

motors

Image Processing

- Managed by Mathematica
- binarized to detect its edges (**Figure 6**)
- back into its proper position





Figure 5: Microscope image capture of the bottom right corner of a test sample