Development of an Advanced Nanocalorimetry System for Rapid Screening of Energetic Materials

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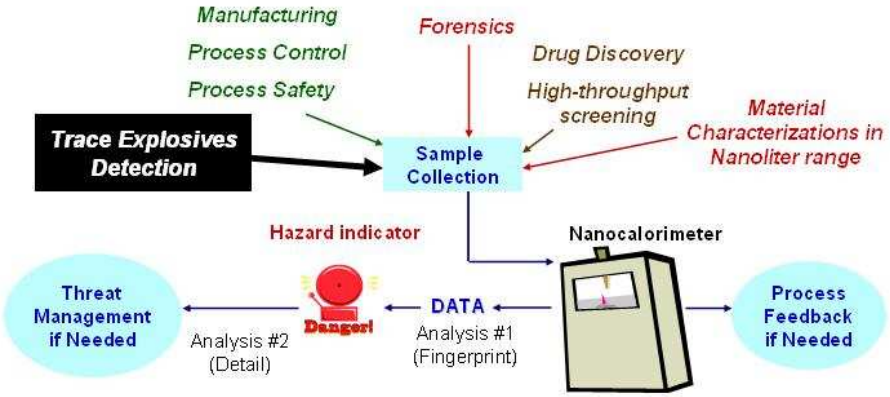

Figure 1. Application areas of the nanocalorimetry system

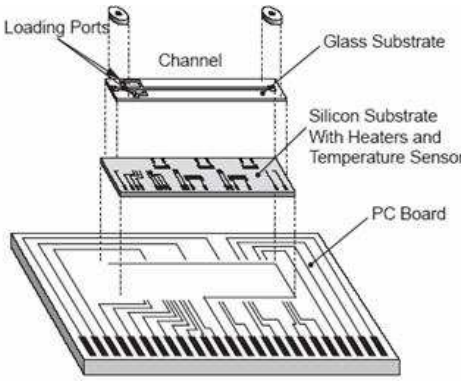

Figure 2. Prototype of a miniaturized reactor

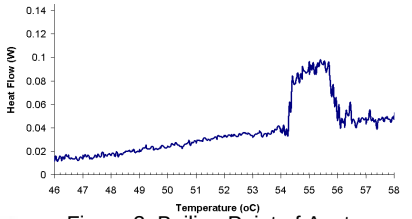

Figure 3. Boiling Point of Acetone

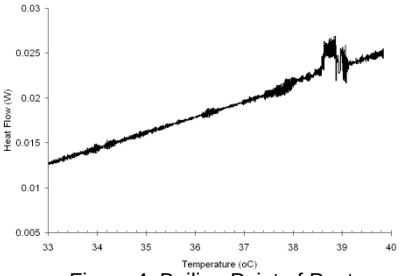

Figure 4. Boiling Point of Pentane

The Advanced Nanocalorimeter for Rapid Screening of Energetic Materials:

The development of a versatile system capable of providing rapid, portable, and inexpensive detection of explosives and energetic compounds is critically needed to offer an enhanced level of protection against threats to homeland security, as well as to satisfy a wide range of applications in the fields of forensic analysis, and industrial hazards analysis. The nanocalorimeter will serve as a first-of-its-kind screening tools for explosive and energetic compounds directly in the settings where they are needed with high efficiency, reduced cost, and simplicity with ease of use. Unlike current explosives detectors, this system is based on calorimetric techniques that are inherently capable of providing direct measurements of energy release potential and therefore do not depend on prior knowledge of familiar compounds. The microfabricated calorimetry instrument consists of (i) a *thermal control module* incorporating arrays of microfabricated heaters and temperature sensors, and (ii) a *sample encapsulation module* (Fig. 2). Initial work has led to successful fabrication of a chip capable of sampling nano-sized solid or liquid compounds. Control algorithms incorporating the DSC principle have also been written using LabVIEW. Device performance of the original and redesigned chips were tested by studying the thermal transitions associated with the boiling points of acetone and pentane (Fig. 3 & 4).

Conclusions and Future Work:

The nanocalorimeter will aid in advanced sensing for the use in homeland security, chemical process safety, and military applications. Future work will focus on modifying the chip design and control algorithm to improve accuracy and sensitivity, developing a trace analysis software to link it to a database of explosive information, and adapting different fabrication procedure for high temperature operation and large scale production.

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Yeah. But it doesn't smell like a bomb.

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