December 2011 MSS/LPS/SPS Joint Subcommittee Meeting
ABSTRACT SUBMITTAL FORM

The submission of an abstract is an agreement to complete a final paper for publication and attend the meeting to present this information. Complete all information requested in the author and co-author information sections; the first author listed will receive paper acceptance notices and all correspondence. Abstracts must be <u>submitted electronically</u>; submittal instructions are located in the call for papers. **The abstract deadline date is June 13, 2011.**

ABSTRACT INFORMATION

Title: Demonstration of a Fiber Optic Regression Probe in a High-Temperature Flow

Submitted for consideration to: ☐ MSS ☐ LPS ☑ SPS

For inclusion in Technical Area: ☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

Security Classification of Presentation: ☑ Unclassified

Security Classification of Paper: ☑ Unclassified

Contract Number(s) Under Which Work was Performed: _____ ☐ IR&D

Is this paper an update? ☐ Yes ☑ No   Has it been presented elsewhere? ☐ Yes ☐ No   Is this a student paper? ☐ Yes ☐ No

AUTHOR INFORMATION

Author/Presenter Name: Valentin Korman

Affiliation K Sciences, LLC

Address 118 Darlington Rd.

City Huntsville   State AL   Zip 35801

Telephone 256-682-4743   Telefax

e-mail: vkorman@k-sciences.com

2nd Author: Kurt Polzin

Affiliation NASA-MSFC

Address NASA-MSFC / ER24

City Huntsville   State AL   Zip 35812

Telephone 256-544-5513   Telefax 256-544-2216

e-mail: kurt.a.polzin@nasa.gov

3rd Author:

Affiliation

Address

City   State   Zip

Telephone   Telefax

e-mail:

Additional Author(s):

Affiliation

Address

City   State   Zip

Telephone   Telefax

e-mail:

MANAGEMENT APPROVAL

The individual below certifies that the required resources are available to present this paper at the above subject JANNAF meeting.

Responsible Manager authorizing presentation: Mr. James Martin

Title/Agency: Branch Chief/NASA-MSFC

Telephone Number: 256-544-6054   e-mail: jim.j.martin@nasa.gov   Date:

Unclassified Abstract
(250-300 words; do not include figures or tables)

The capability to provide localized, real-time monitoring of material regression rates in various applications has the potential to provide a new stream of data for development testing of various components and systems, as well as serving as a monitoring tool in flight applications. These applications include, but are not limited to, the regression of a combusting solid fuel surface, the ablation of the throat in a chemical rocket or the heat shield of an aeroshell, and the monitoring of erosion in long-life plasma thrusters. The rate of regression in the first application is very fast, while the second and third are increasingly slower.

A recent fundamental sensor development effort has led to a novel regression, erosion, and ablation sensor technology (REAST). The REAST sensor allows for measurement of real-time surface erosion rates at a discrete surface location. The sensor is optical, using two different, co-located fiber-optics to perform the regression measurement. The disparate optical transmission properties of the two fiber-optics makes it possible to measure the regression rate by monitoring the relative light attenuation through the fibers. As the fibers regress along with the parent material in which they are embedded, the relative light intensities through the two fibers changes, providing a measure of the regression rate. The optical nature of the system makes it relatively easy to use in a variety of harsh, high temperature environments, and it is also unaffected by the presence of electric and magnetic fields. In addition, the sensor could be used to perform optical spectroscopy on the light emitted by a process and collected by fibers, giving localized measurements of various properties.

The capability to perform an in-situ measurement of material regression rates is useful in addressing a variety of physical issues in various applications. An in-situ measurement allows for real-time data regarding the erosion rates, providing a quick method for empirically anchoring any analysis geared towards lifetime qualification. Erosion rate data over an operating envelope could also be useful in the modeling detailed physical processes.

The sensor has been embedded in many regressing media to demonstrate the capabilities in a number of regressing environments. In the present work, sensors were installed in the eroding/regressing throat region of a converging-diverging flow, with the working gas heated to high temperatures by means of a high-pressure arc discharge at steady-state discharge power levels up to 500 kW. The amount of regression observed in each material sample was quantified using a later profilometer, which was compared to the in-situ erosion measurements to demonstrate the efficacy of the measurement technique in very harsh, high-temperature environments.