UNCLASSIFIED

THERMAL ANALYSES OF THE $TiH_x/KClO_4$ SYSTEM

John W. Reed, Jerry L. Ivey,
Carl L. Fread, R. Henry
Steinmeyer, Ralph L. Yaeger,
and George C. Abell

Typical pyrotechnic reaction exotherms are shown in Figure 1 for a number of pyrotechnic blends prepared from titanium hydrides of several hydride compositions. The rate appears to increase with increasing hydrogen in the titanium hydride. The rate increase may be associated with the improved oxidizer-to-fuel ratio.

Computations were carried out to fit the output data from the differential scanning calorimeter to a theoretical chemical kinetic equation. This work was done to obtain parameters for use in mathematical modeling of the pyrotechnic initiation process. The output of the differential scanning calorimeter consisting of dQ/dt , the rate of heat release, and temperature are sufficient data for the computation.

The kinetic equation to which the data was fitted is:

$$dq/dt = A (Q)^n e^{-E/RT} \quad (1)$$

in which,

$$Q_i = \left[1 - \frac{\int_0^{T_i} (dq/dt) dt}{\int_0^{\infty} (dq/dt) dt} \right], \quad (2)$$

where data points $(dq/dt)_i$ and T_i represent the relative amount of reactive material remaining at temperature T_i which corresponds to time t_i , and where

dq/dt = energy release ($\text{cal g}^{-1} \text{sec}^{-1}$).

T = temperature (K).

t = time (sec).

R = gas constant ($\text{cal mole}^{-1} \text{K}^{-1}$).

A = amplitude factor ($\text{mcal mg}^{-1} \text{sec}^{-1}$).

n = reaction order.

E = activation energy (kcal mole^{-1}).

FIGURE 1 - Typical pyrotechnic reaction exotherms as a function of TiH_x stoichiometry for the system $TiH_x/KClO_4$ (33/67).

UNCLASSIFIED

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.