Ion Sensors for Explosions

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Introduction

• Previous work with individual or multiple discrete electrodes allowed detection of the ions flame front of a butane air explosion

• Electrochem 2007 discussion with Darren Carruana suggested the consideration of the Langmuir probe approach to the explosion measurement
Introduction

• The Langmuir probe is used in plasmas and is essentially a voltage scan technique during which the current is measured (voltages typically -100V to +100V).
• It allows the identification of plasma parameters such as the electron temperature of the plasma and the ion saturation current.
Voltammetry in flames

Investigation of Butane/air explosions

Electrochemical- Voltammetry

Evidence from flames

Attempts at voltammetry in the explosion
Flames

• In the initial part of the work a flame was used as it is easier to make measurements in the flame than in the explosion because of the short duration of the explosion.
Flame with 2 electrodes

Electrodes
Larger dia I meas.
Smaller dia V appl.
Current potential curve two electrodes in flame.
Potential on smaller diameter electrode

Current/A

Potential applied/V

Series1
Flame focussed on larger diameter electrode 1808r17 1Hz 10V pp
Flame focused on smaller diameter electrode 1808r16 1Hz 10V pp
Flame between electrodes 1808r18 1Hz 10V pp
Current with probe voltage -30V 10909r11

Series 1
Tube with probe 10Hz 10V 50ms time base

Potential/V vs Current/A graph for Series 1.
Probe current vs time

-2.00E-07 -1.00E-07 0.00E+00
1.00E-07 2.00E-07 3.00E-07 4.00E-07 5.00E-07 6.00E-07 7.00E-07
0 0.01 0.02 0.03 0.04 0.05 0.06

Time/s

Current/A

Series1
Tube with probe 70Hz 10V pp 50ms

Potential/V

Current/A

Series 1
Conclusions

• It is possible to carry out a voltammetric scan in the flame front of the explosion

• Conditions need to be optimised

• Underlying theory needs to be considered and potential scan range extended
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