Ions in the oxyfuel cutting flame due to work piece carbon

Christopher Martin[a,b] Devin Oswald[a]
S. M. Mahbobur Rahman[c] Alexandrina Untaroiu[c]

[a]Penn State Altoona
[b]email: crm28@psu.edu
[c]Virginia Tech

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Abstract

Experiments demonstrate that carbon in the work piece is a major source for secondary ions in the oxyfuel cutting flame. New sensing techniques replace traditional active sensors by monitoring the ion currents caused by the primary ions that are the natural byproducts of combustion, but secondary ions generated chemically at the work surface have been found to complicate the resulting signals. In the present work, ion currents through the oxyfuel flame are monitored while controlling for the addition of carbon in the outer flame. Wires of different carbon content are burned while holding all other conditions constant, and fluidized graphite dust is injected into the flame at controlled flow rates. Both experiments demonstrate that the addition of carbon in the outer cone dramatically enhances ion currents, but carbon in the material being burned is about twenty times more effective at producing ion currents.

1 Introduction

This is an experimental investigation into the unknown origins of secondary ions in the oxyfuel cutting flame motivated by their impact on ion current sensing systems.

Oxyfuel cutting is a century-old process that has remained ubiquitous for its low cost and superior performance on thick steel. However, persistent shortcomings in the commercially available sensor suites have prevented multi-torch mechanized oxyfuel tables from obtaining the level of automation mandated by most contemporary manufacturing facilities. Recent advances in ion current sensing have leveraged the semiconductor characteristics of the preheat flame by passing weak electrical currents between the torch and work to form a sensor [3, 2]. The process has been shown to provide measurements of standoff and cut health [6, 4, 5].