

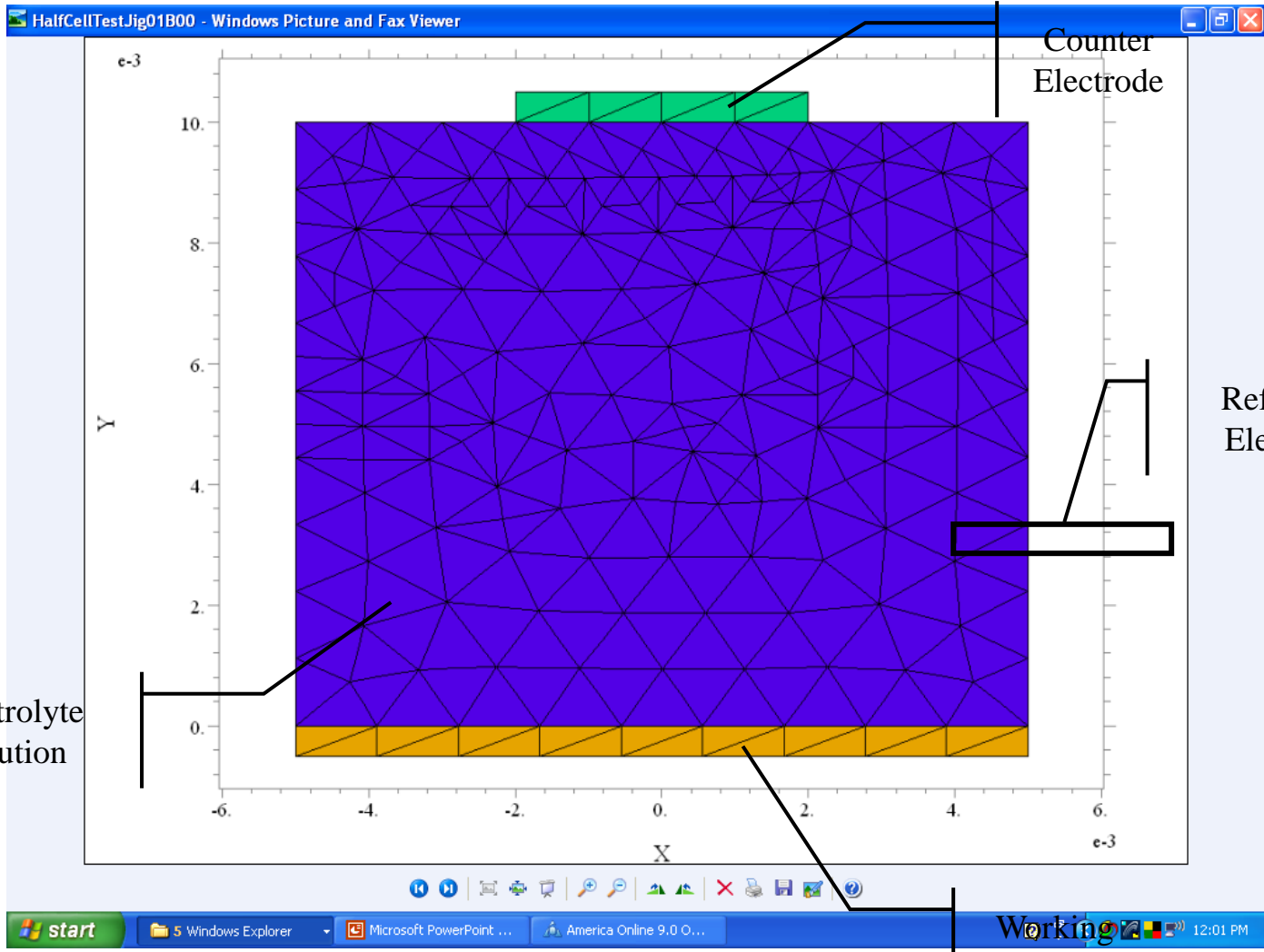
# Current Flow and Power Dissipation in a Miniature Half Cell

A Finite Element Analysis ( FEA ) using flexPDE

Craig E. Nelson - Consultant Engineer

The purpose of this numerical experiment is to learn about the field distribution of potential, current and dissipation in a miniature half cell test jig.

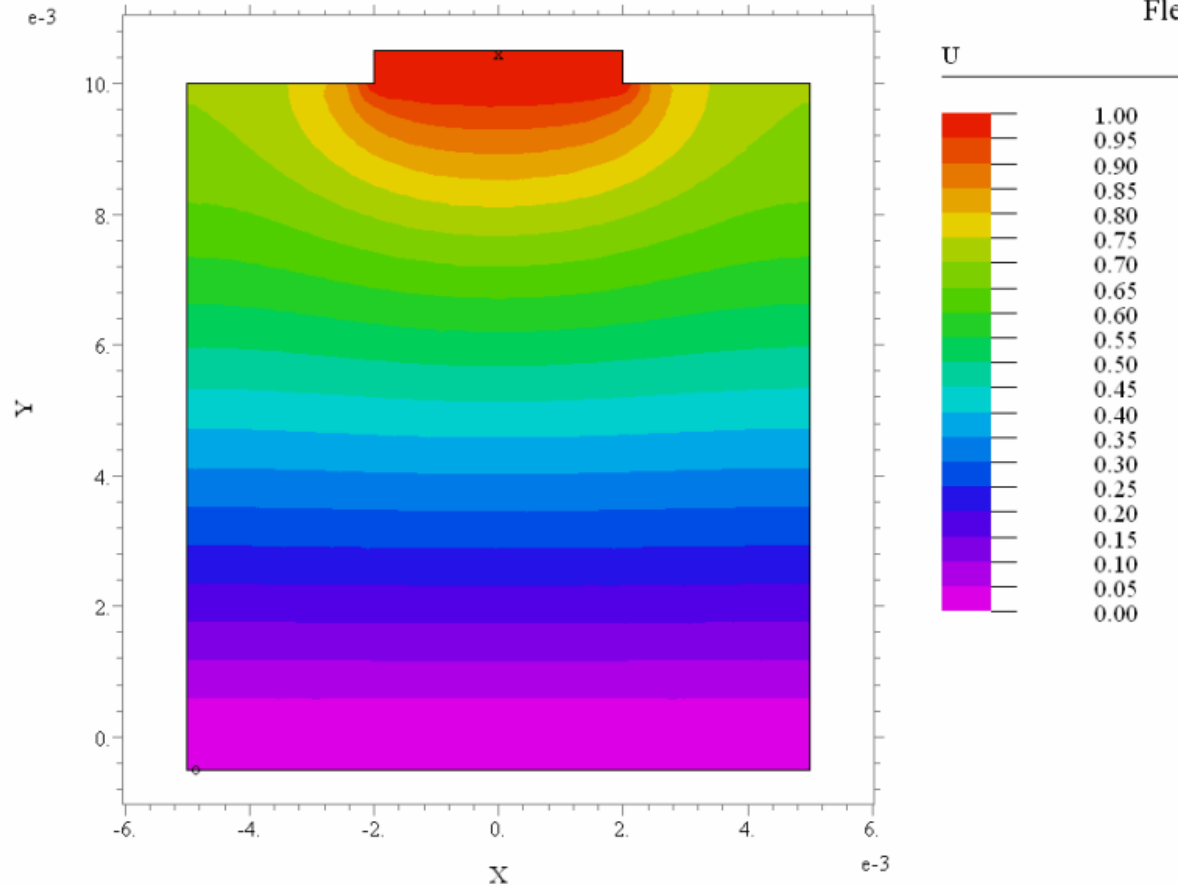
This knowledge helps the researcher to better understand where to place or not place a reference electrode.



Half Cell Test Jig Geometry

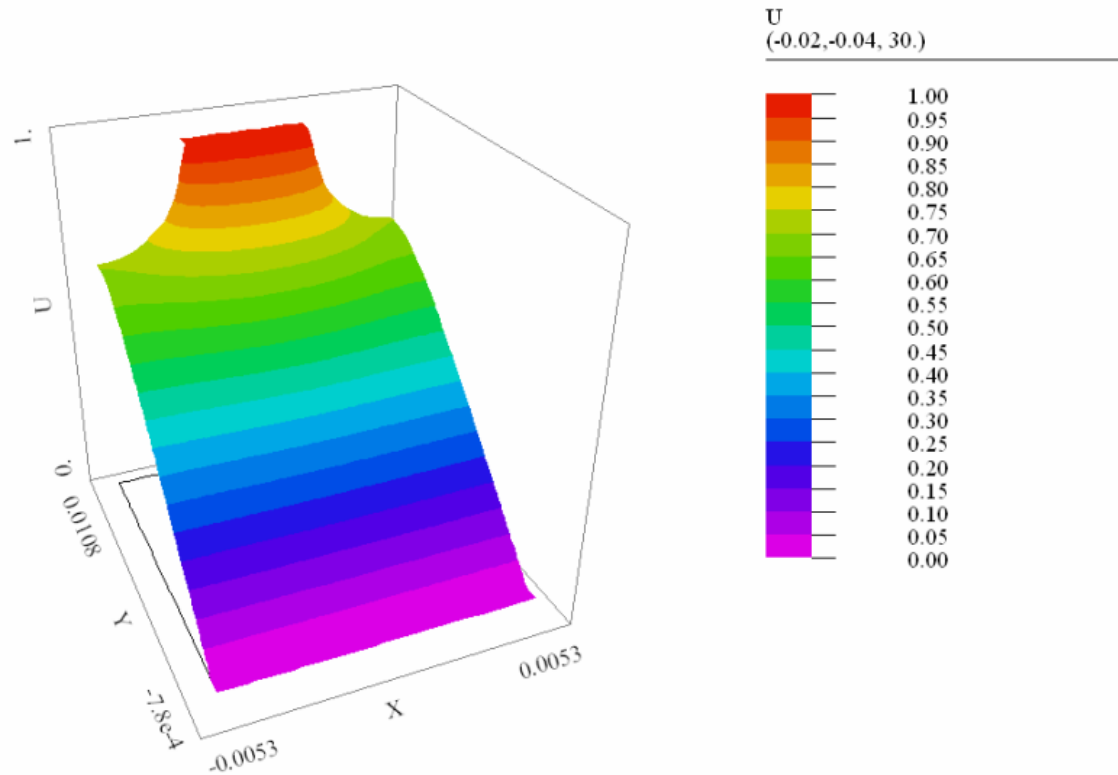
Working Electrode

### Conduction in a Test Fixture



HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018

### Potential Field Distribution – Contour Plot

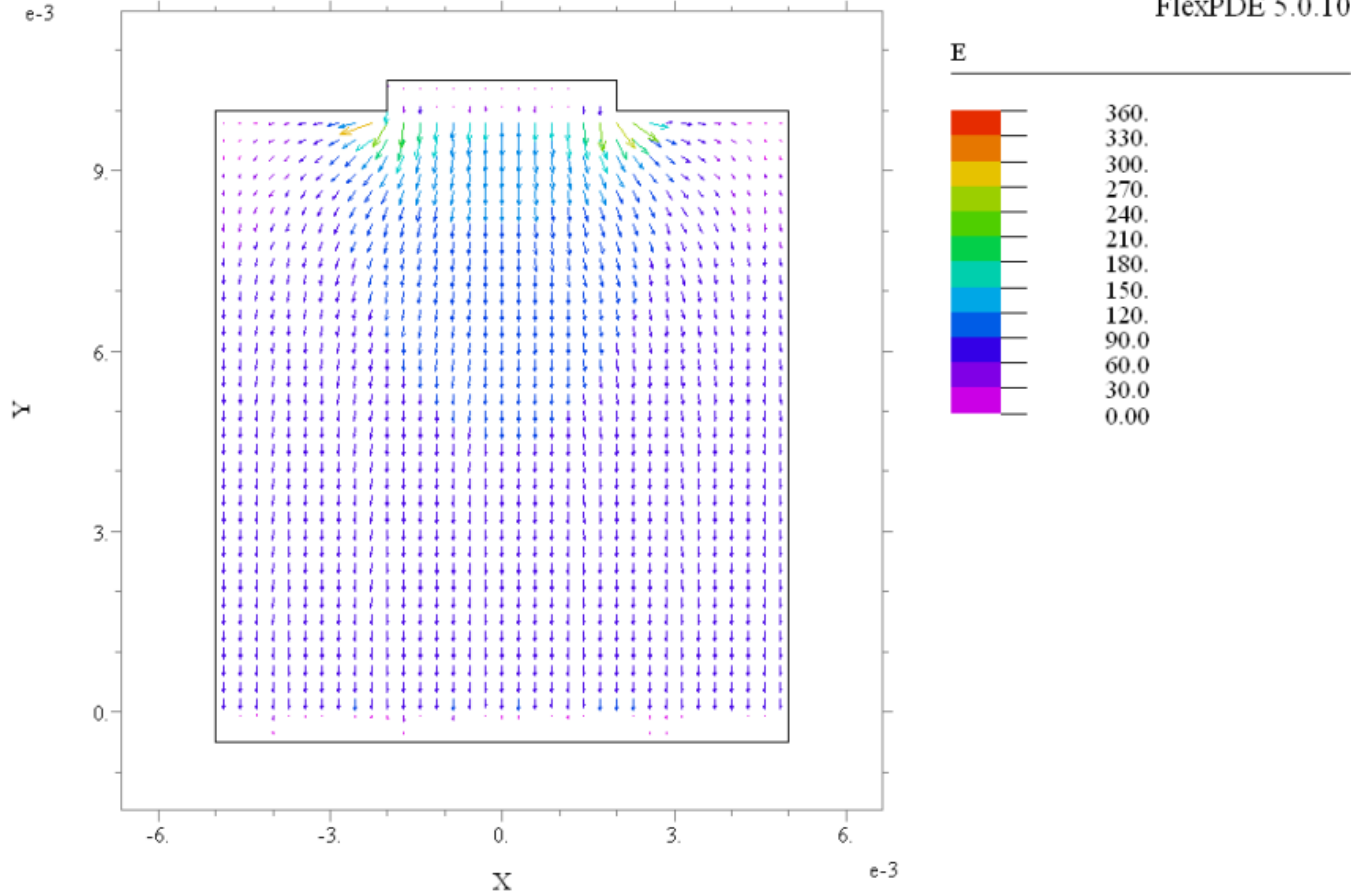


HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018  
Integral= 4.512511e-5

### Potential Field Distribution – 3D Plot

Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10

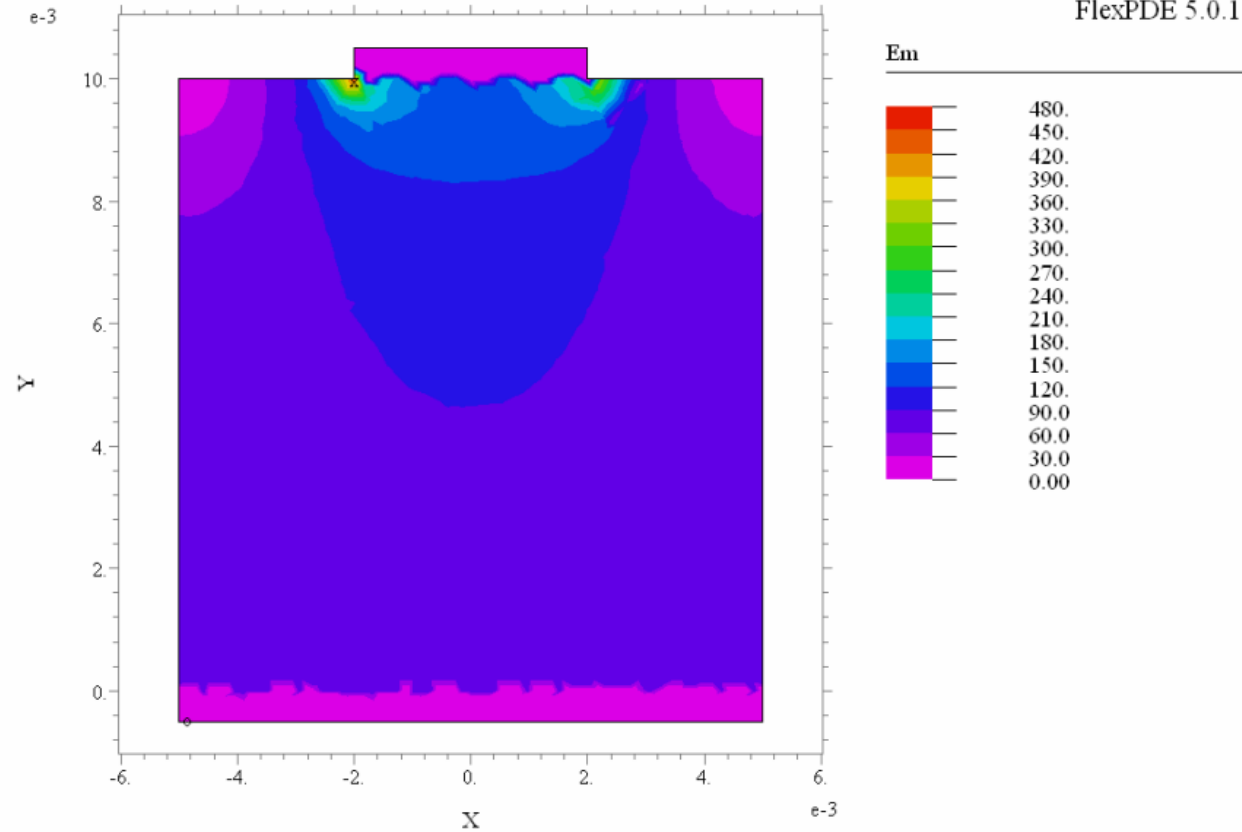


HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018

E Field Distribution – Vector Plot

Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10

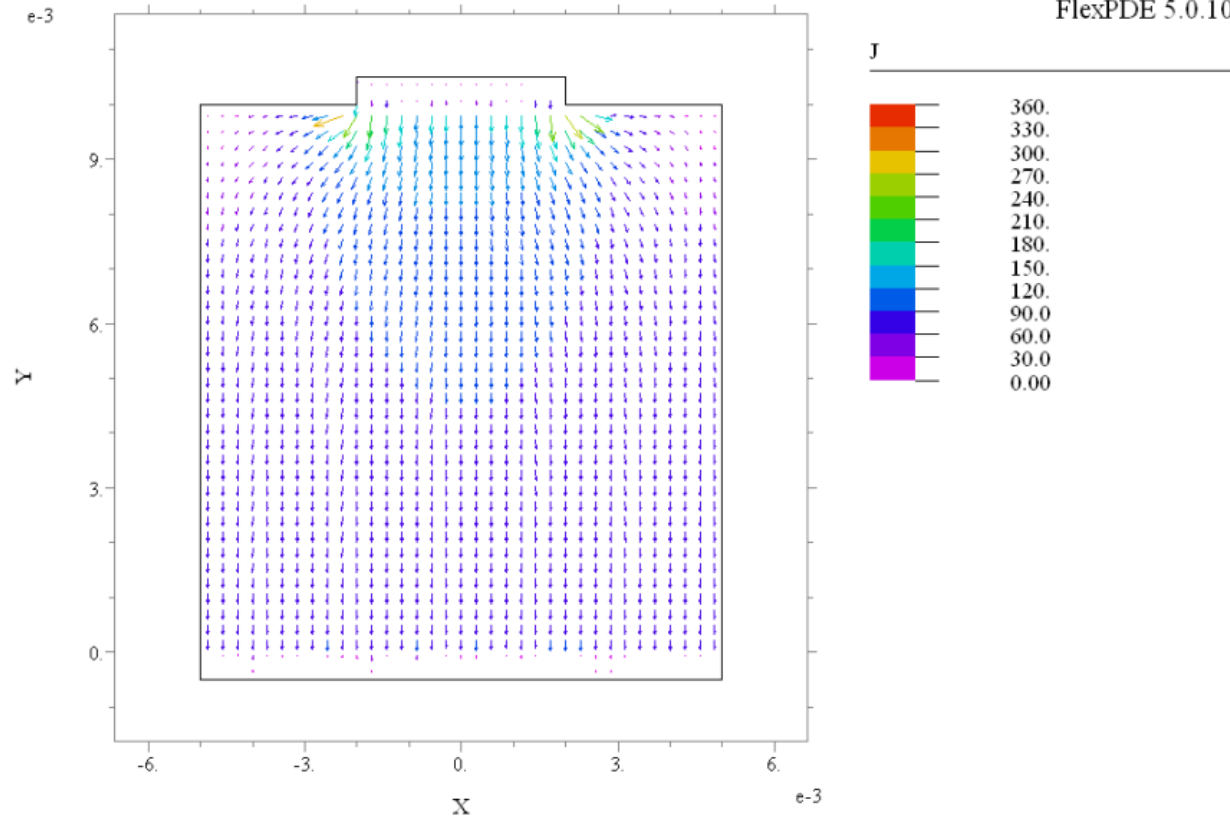


HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018  
Integral= 8.927757e-3

## E Field Magnitude Distribution – Contour Plot

Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10



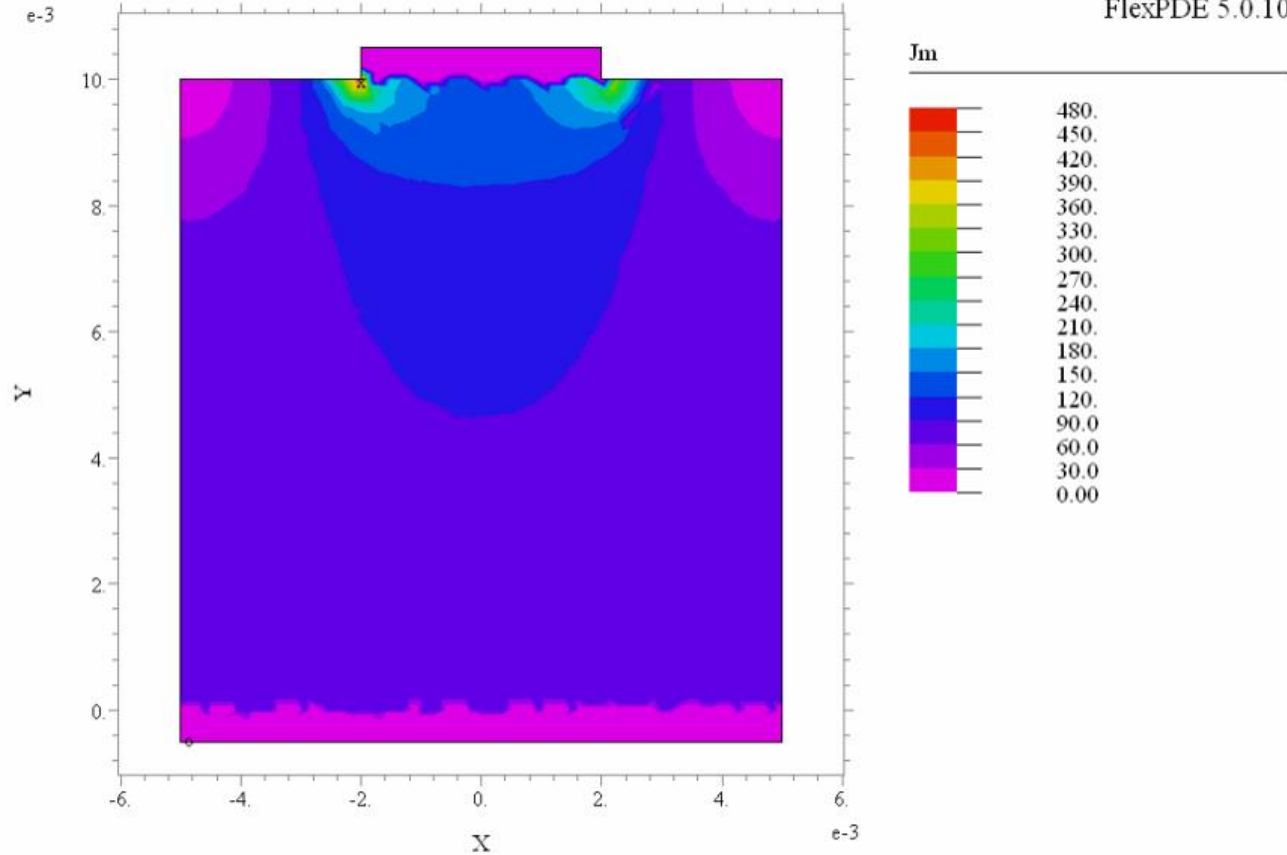
HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018

## Current Density Distribution – Vector Plot



Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10

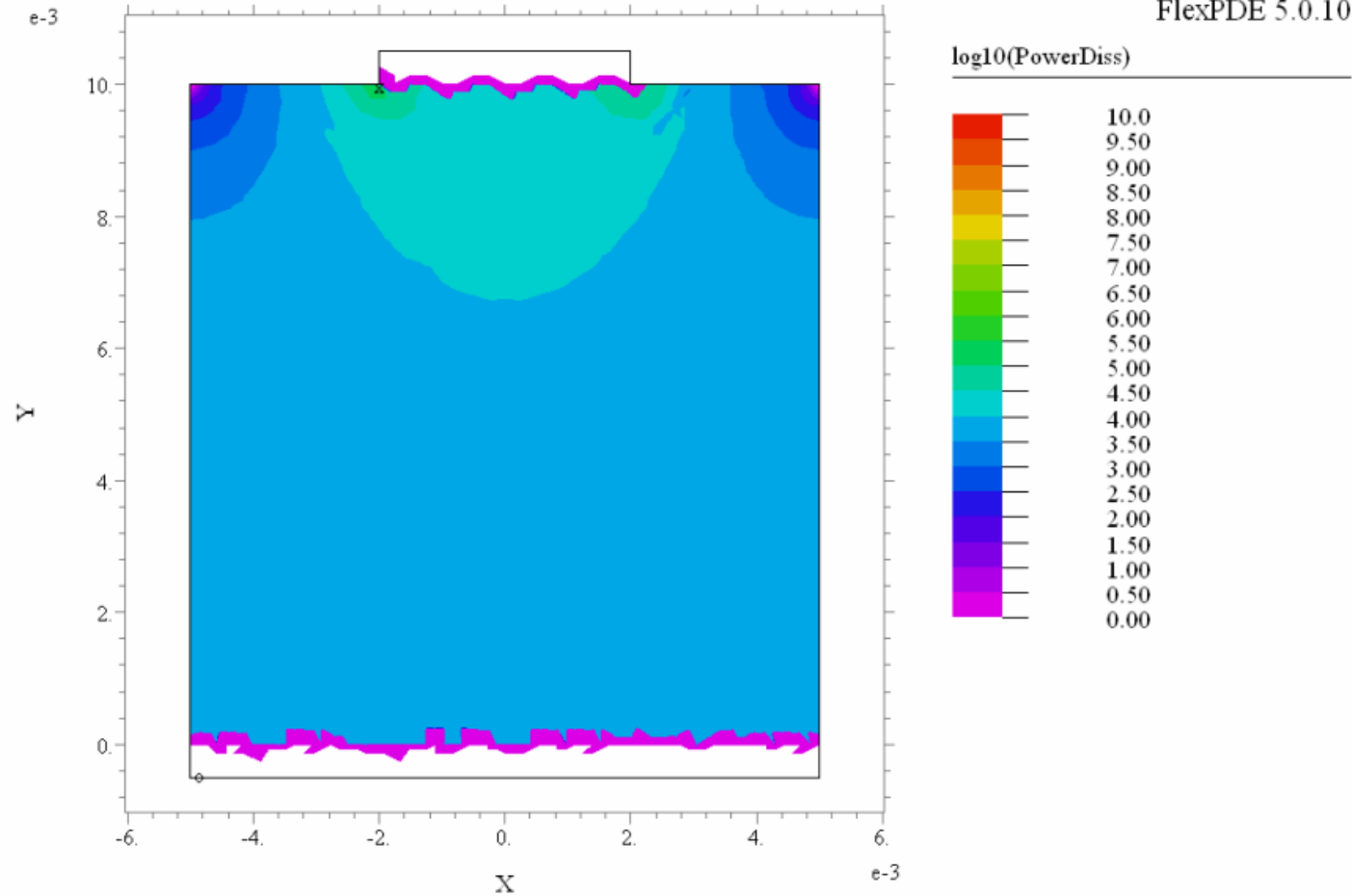


HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018  
Integral= 8.927757e-3

Current Density Magnitude Distribution – Contour Plot

### Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10

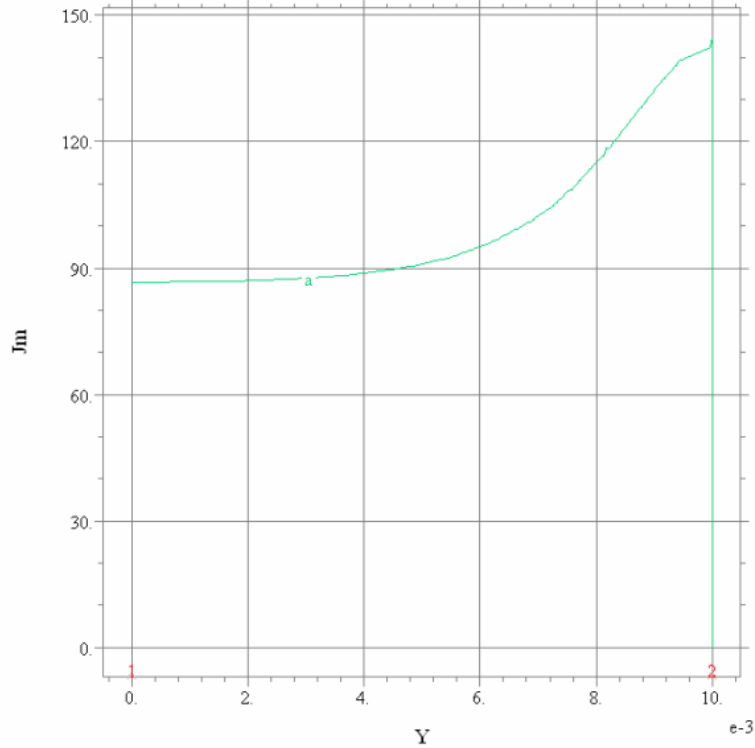


HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018  
Integral= -1.561483e-3

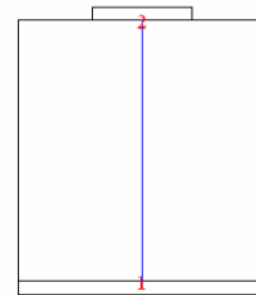
### Power Density Distribution – Log 10 - Contour Plot

Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10



Jm  
from (0,0)  
to (0,Ly)  
a: Jm

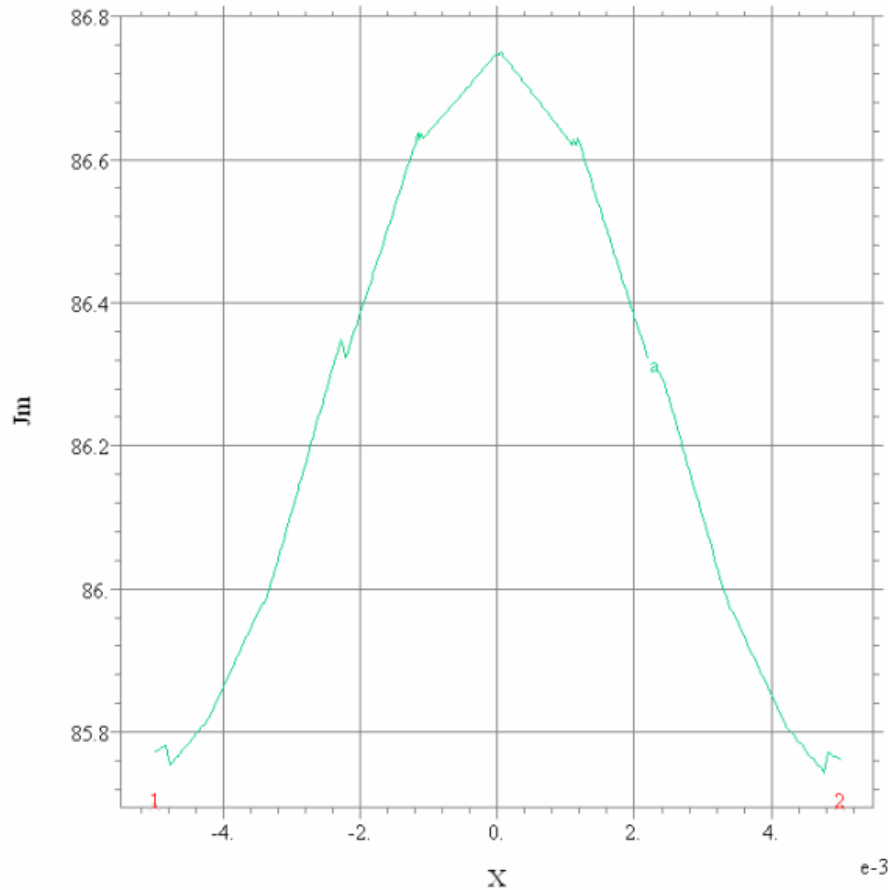


HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018  
Integral= 1.000008

## Current Density Distribution – On Cell vertical Axis

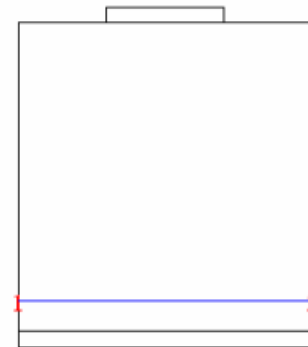
### Conduction in a Test Fixture

11:52:04 7/20/07  
FlexPDE 5.0.10



Jm  
from (-L1,1\*Ly)  
to (L1,1\*Ly)

a: Jm



HalfCellTestJig01B: Grid#2 P2 Nodes=801 Cells=378 RMS Err= 0.0018  
Integral= 0.862468

## Current Density Distribution – Near the Working Electrode

## Summary and Conclusions

A finite element model has been developed that allows insight into the nature and magnitude of electric, current and power dissipation fields in a very small half cell test jig

The model could be further developed in many further ways.