Study of Heat Flux in a Thin Silicon MEMS Wafer with Coolant and Air-Filled Regions

A Finite Element Model (FEA) using flexPDE

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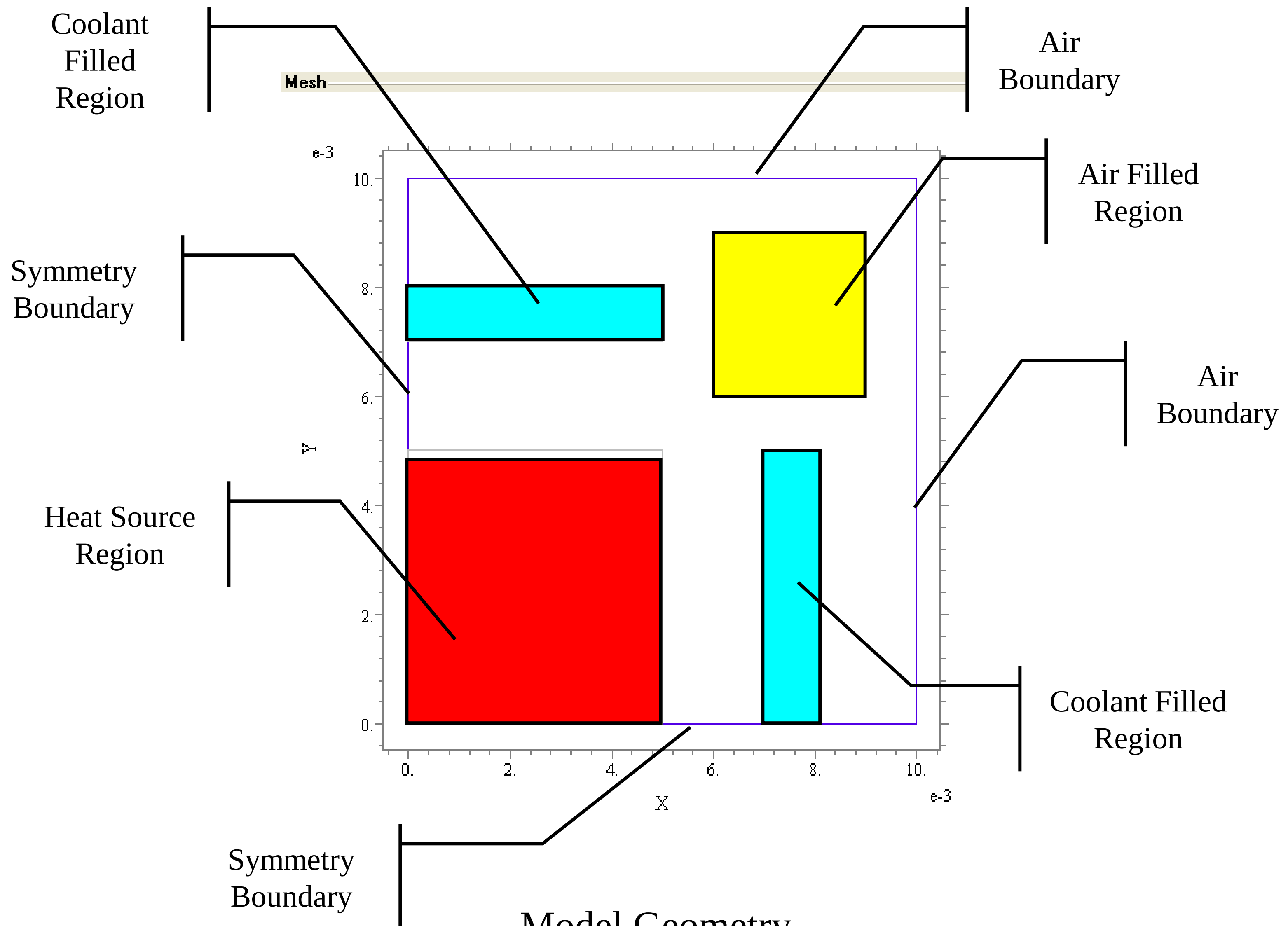
Goal for the Numerical Study

A steady state finite element model is to be developed that aids understanding of heat flux within a silicon MEMS wafer.

Heat is produced in a rectangular, constant intensity (power per unit area), source region. The heat then diffuses into the surrounding silicon regions and is carried away by cooling fluid flowing in rectangular passageways.

Quadrant symmetry will be used to reduce the solution domain complexity.

Model Geometry



Model Geometry

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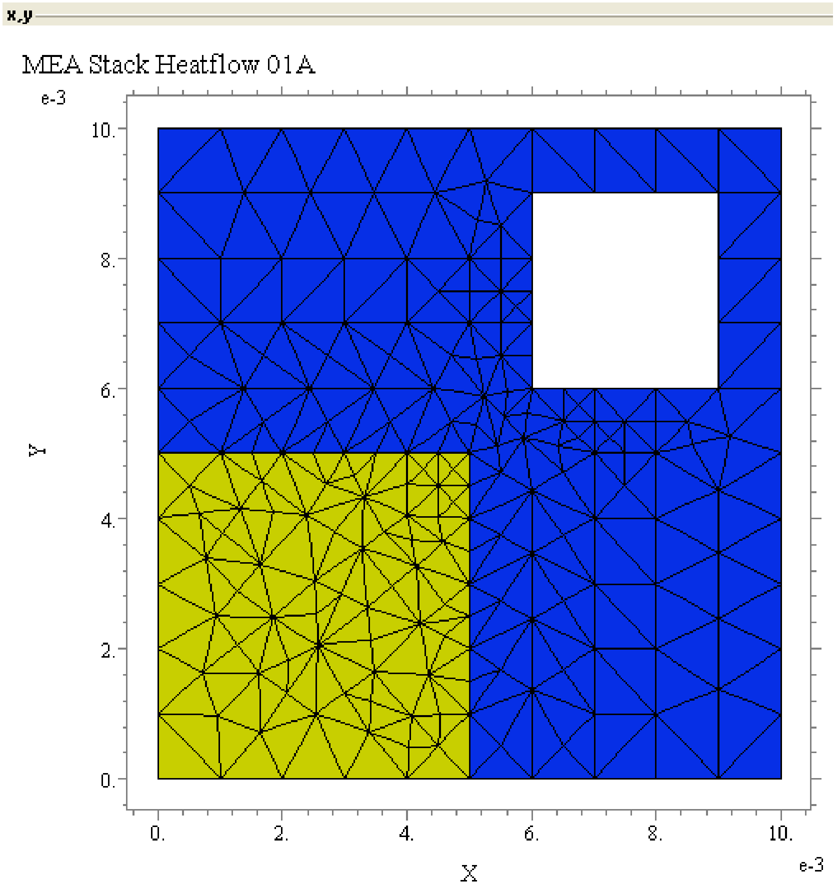

Numerical Solution Grid

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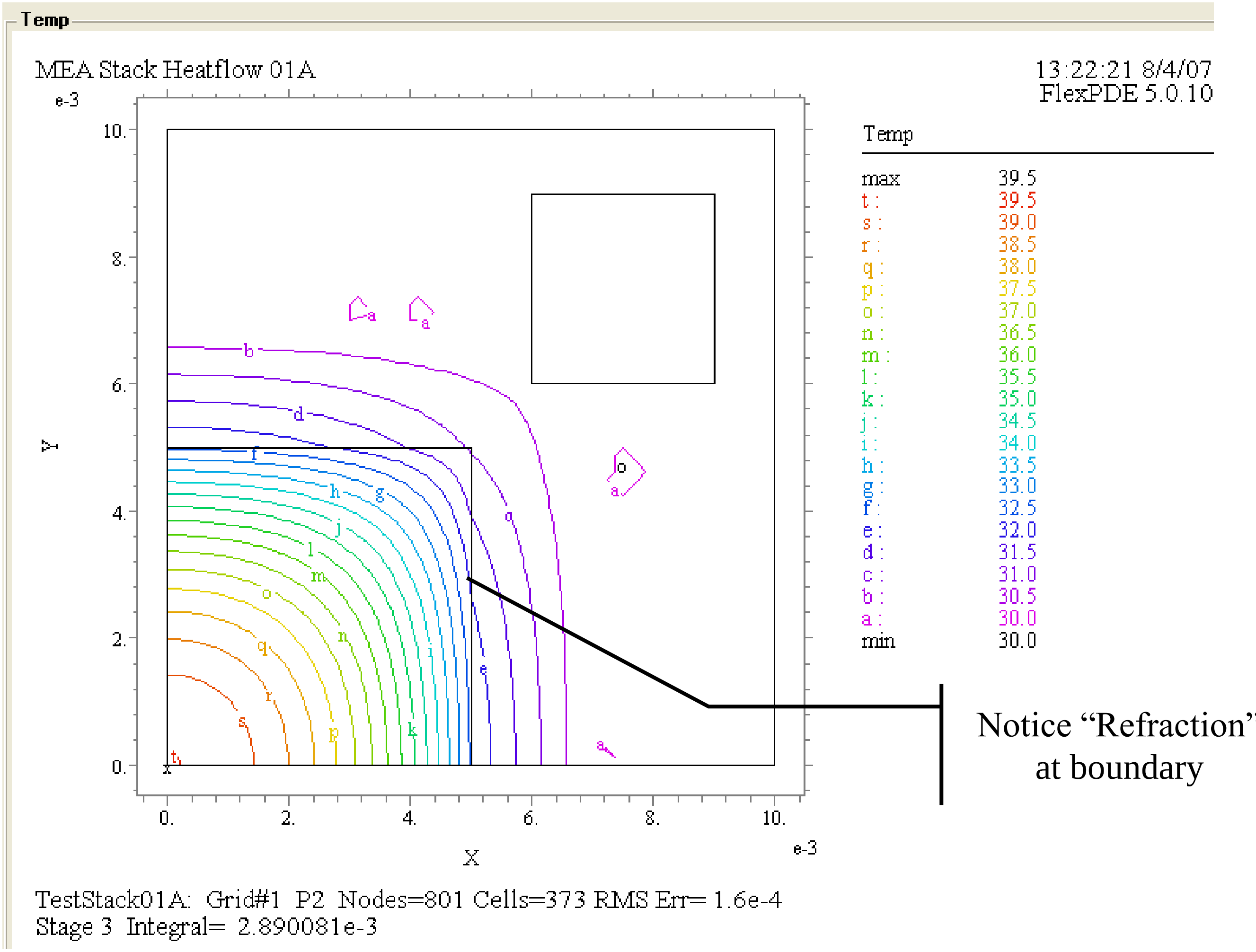
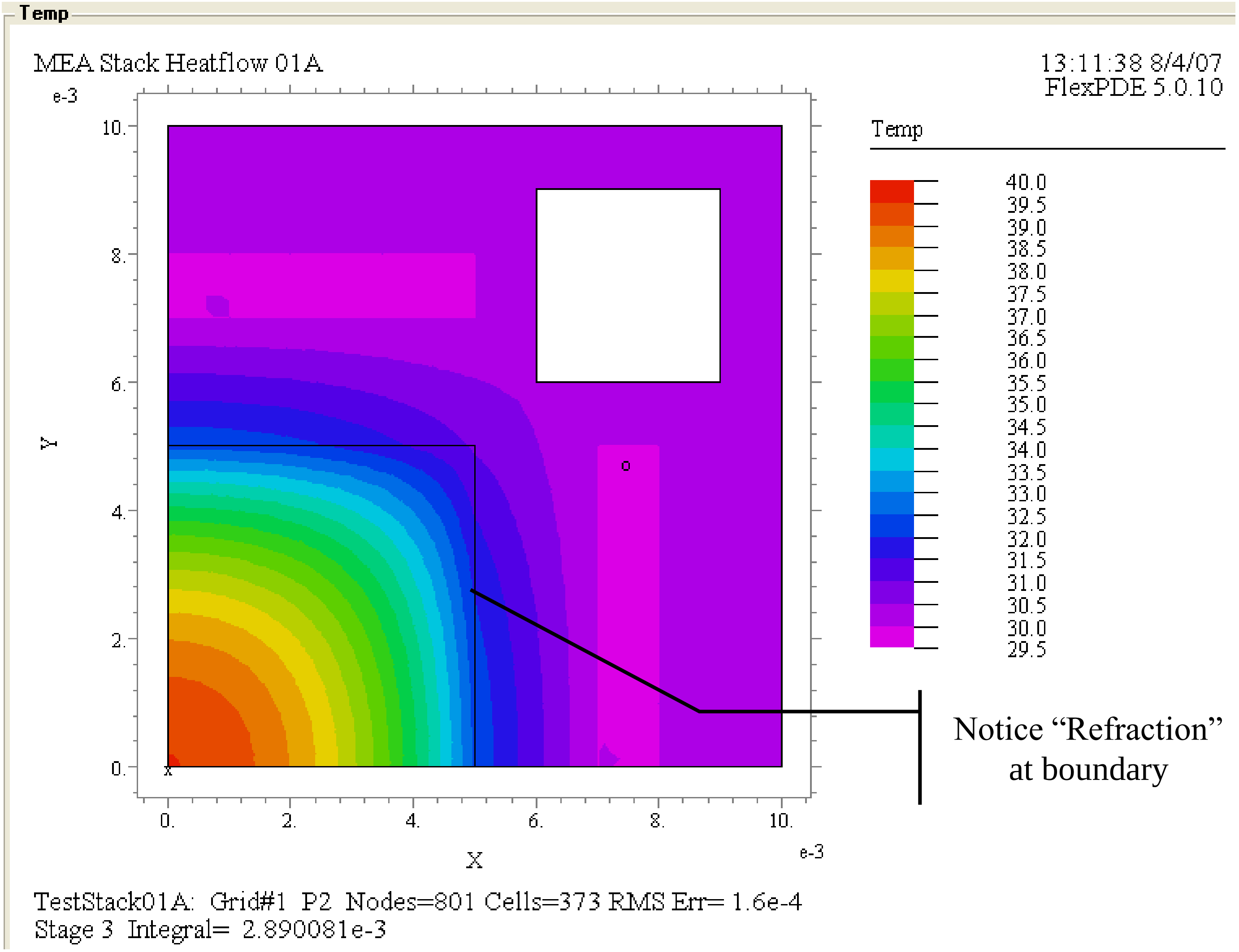
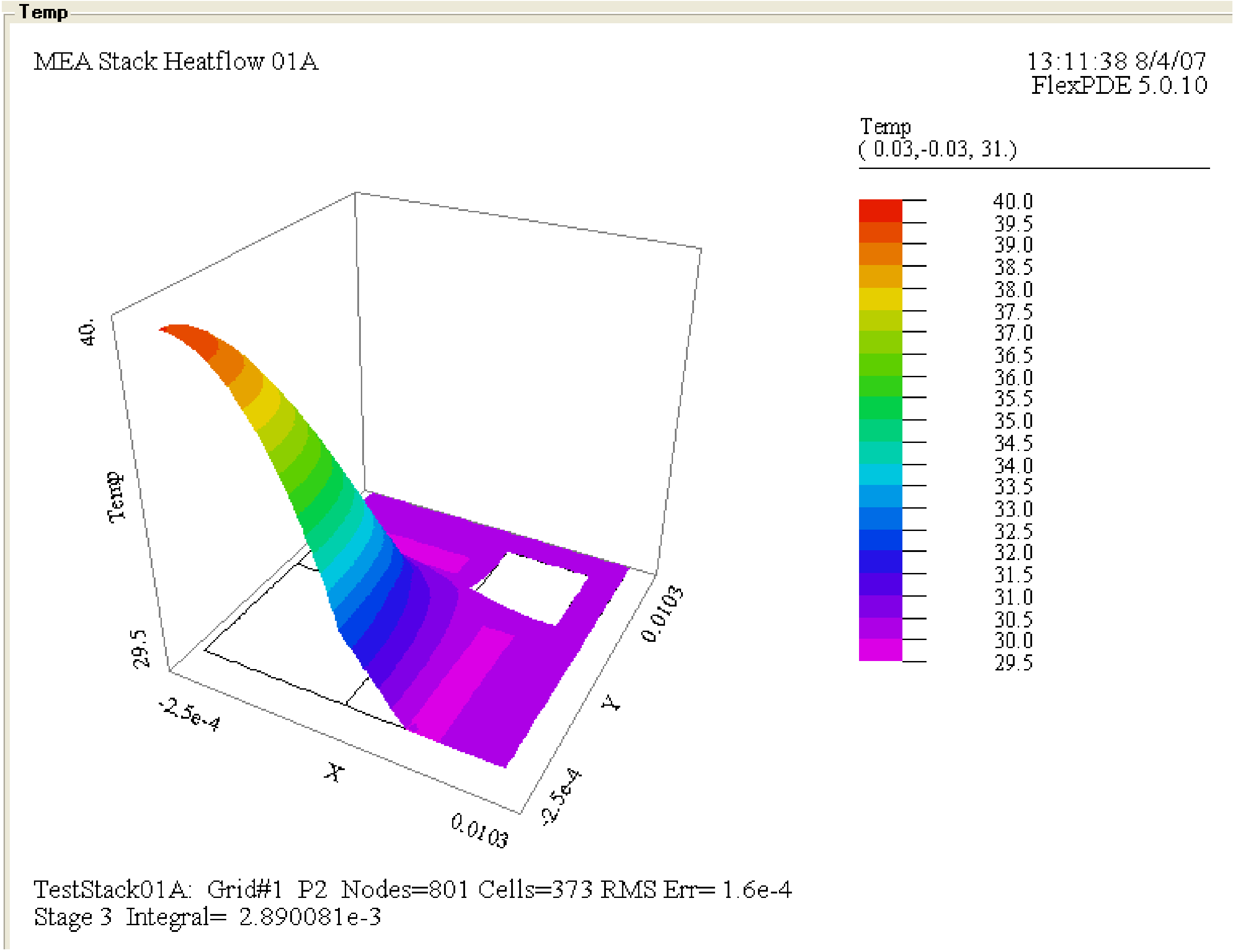
Solution Plots



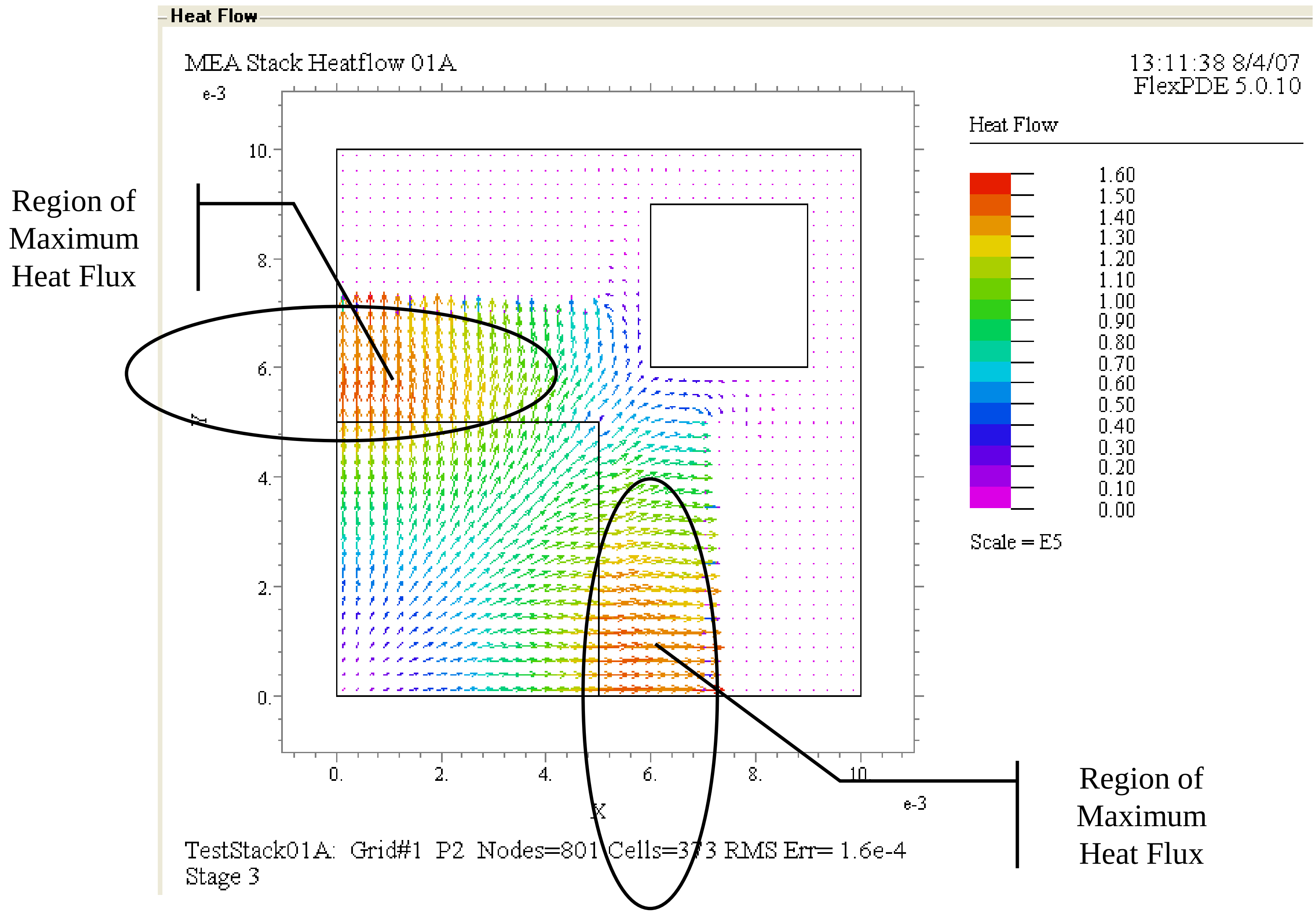
Temperature Field - Contour Plot



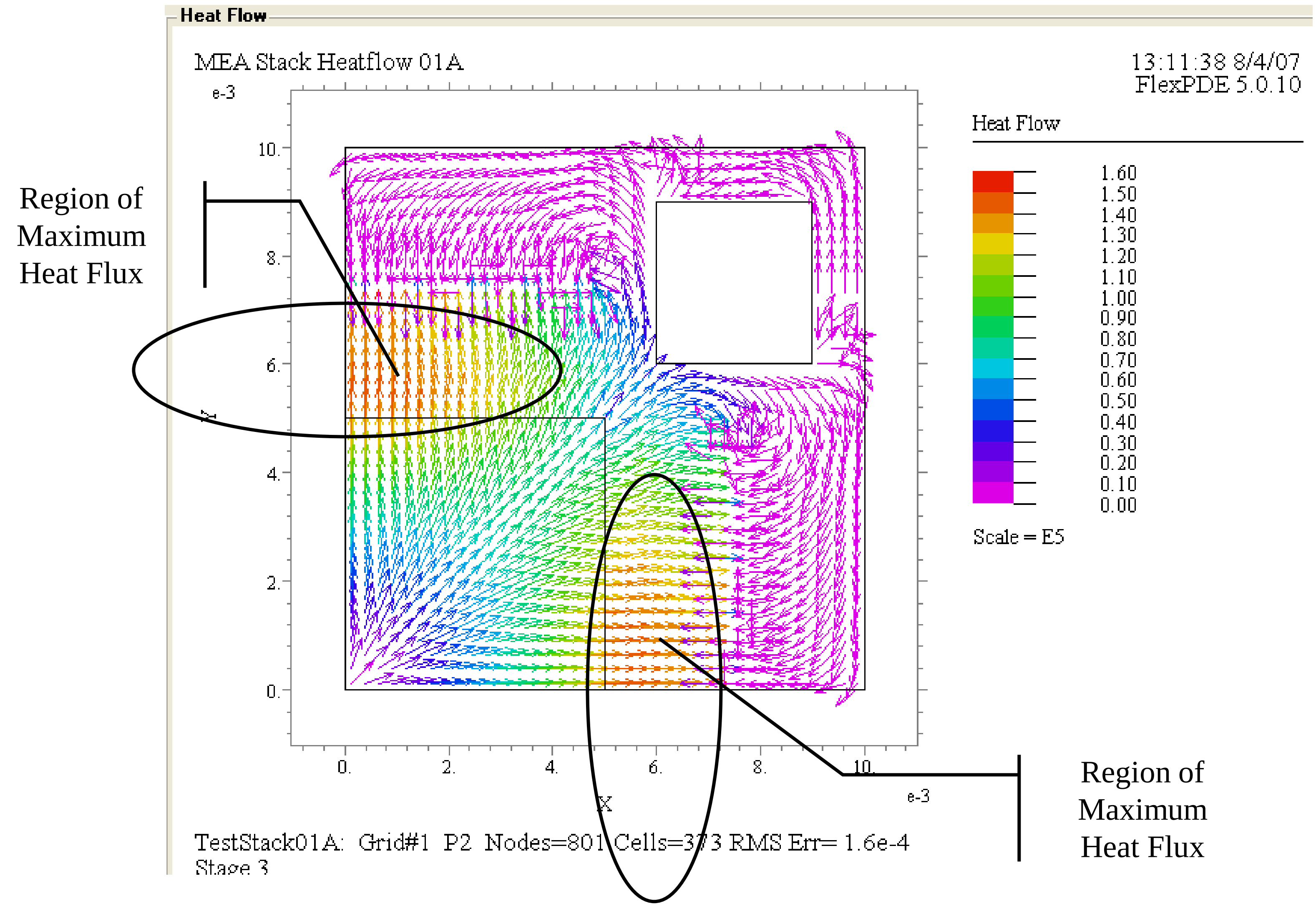
Temperature Field - Contour Plot



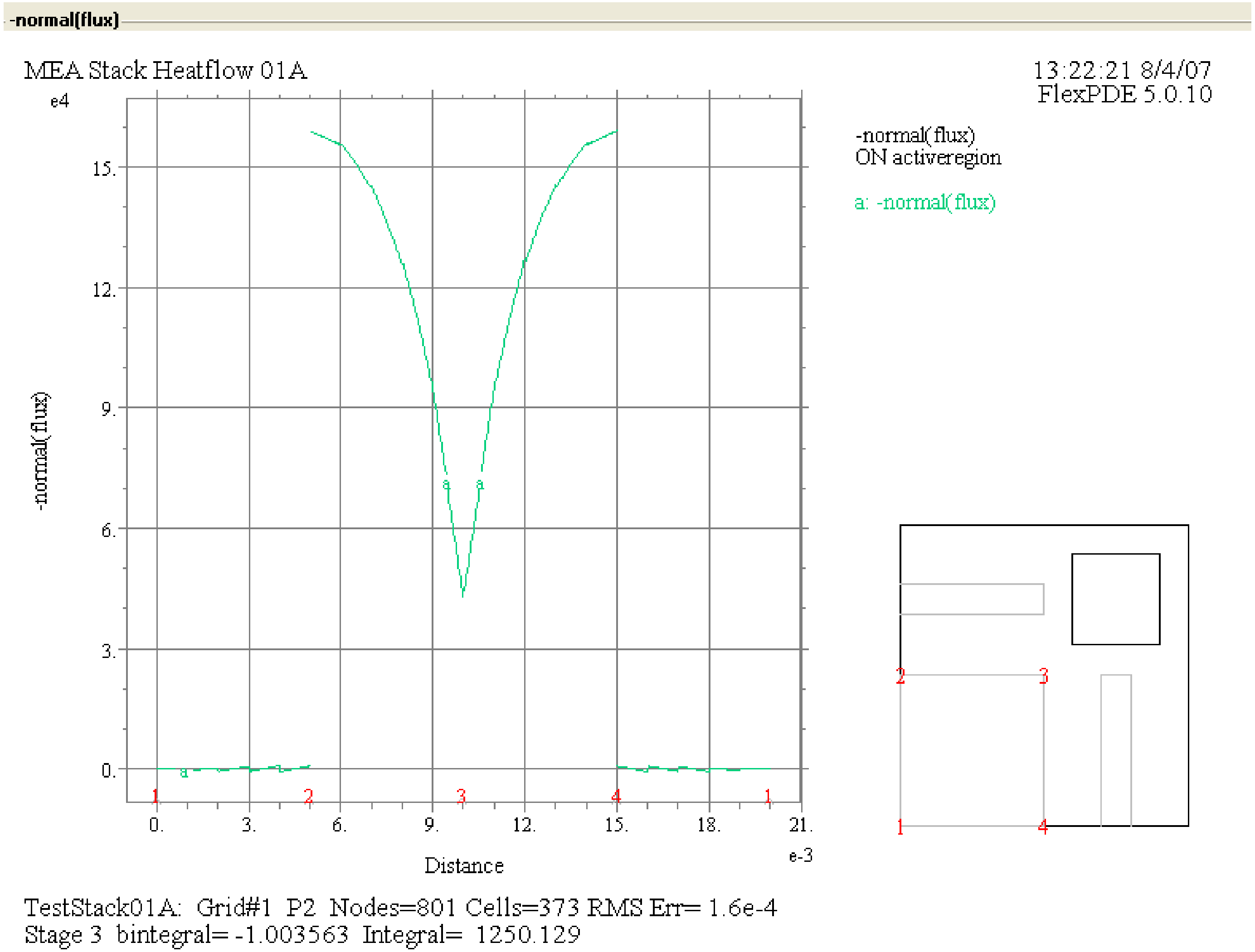
Temperature Field - Surface Plot



Heat Flux Field - Vector Plot



Heat Flux Field - Vector Plot - Normalized



Heat Flux on Source Region Perimeter

Summary

A steady state finite element model has been developed that aids understanding of heat flux and temperature within a silicon MEMS wafer.

Heat is produced in a rectangular, constant intensity (power per unit area), source region. The heat then diffuses into the surrounding silicon regions and is carried away by cooling fluid flowing in rectangular passageways.

Because the thermal conductivity is different in different regions, the resultant temperature field is complex and interesting.

Quadrant symmetry was used to reduce the solution domain complexity.

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