

# Heat Transfer in Crossflow Heat Exchangers for Application with Microreactors

R Pryor<sup>1</sup>

<sup>1</sup>Pryor Knowledge Systems, Inc., Bloomfield Hills, MI, USA

## Abstract

**Introduction:** The development and employment of microreactors, with built-in heat exchangers, has rapidly expanded both the research in and the production of new and exotic chemicals through the exploration of difficult, complex and highly exothermic reaction systems. This paper explores methods of improving the heat transfer coefficient in a crossflow heat exchanger as might be employed in conjunction with an experimental or production microreactor.

**Use of COMSOL Multiphysics®:** The models used in this study are derivatives of the Cross-Flow Heat Exchanger {1} model shipped in the COMSOL Multiphysics® Model Library. In these models, some of the substrate geometries are modified, two additional layers are created and the material copper is used in certain regions, instead of stainless steel. Figure 1 shows the geometry of this set of models. These models use a free tetrahedral mesh with custom parameters. The resulting mesh is shown in Figure 2.

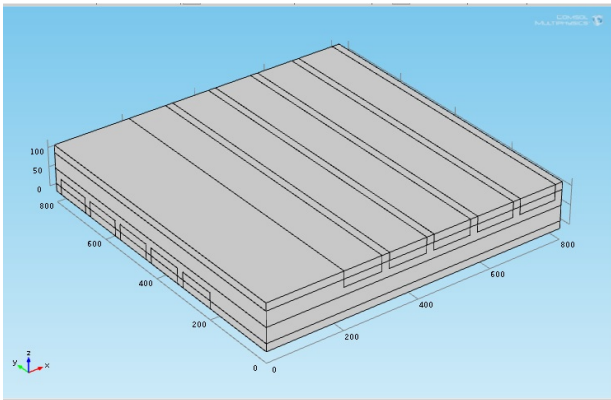
**Results:** The incorporation of additional layers of copper in the center of the crossflow heat exchanger geometry increased the heat transfer coefficient by a factor of approximately 26. Figure 3 shows the temperature at the outlets of the modeled crossflow heat exchanger and the calculated heat transfer coefficient ( $\sim 30,056 \text{ W}/(\text{m}^2 \text{ K})$ ) for this structure.

**Conclusion:** The rate of heat transfer in a crossflow heat exchanger can be significantly increased by structural and materials design modification.

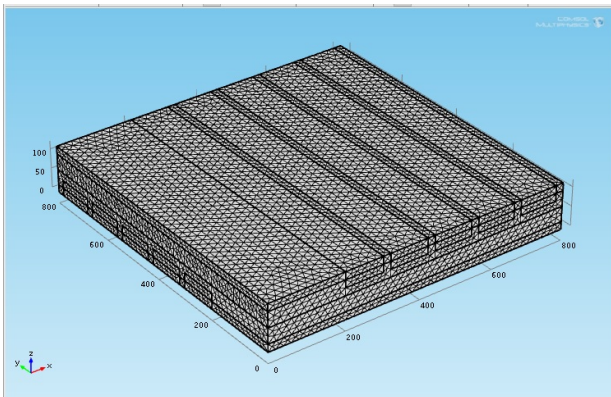
## Reference

1. COMSOL Heat Transfer Module Model Library Manual, pp. 153-171.

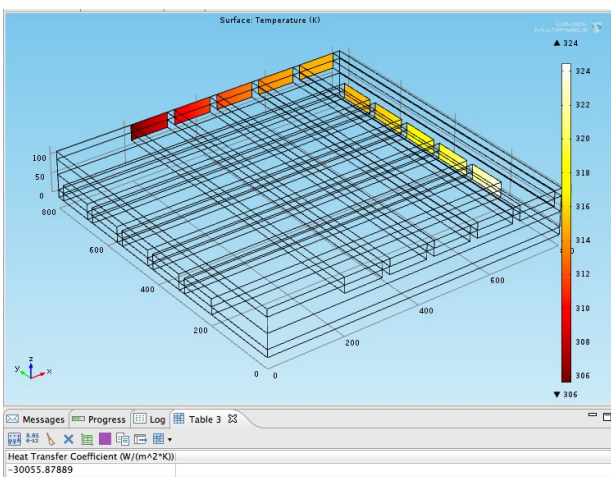
## Figures used in the abstract



**Figure 1:** Crossflow Heat Exchanger Geometry.



**Figure 2:** Crossflow Heat Exchanger Geometry Meshed.



**Figure 3:** Crossflow Heat Exchanger Model Results.

