

**Introduction:** It is possible to convert the wasted heat energy into electrical current by means of thermoelectric modules (TEM). The optimal installation configuration of TEMs for a demo usage in the iron and steel industry are investigated by numerical simulations and experiments.

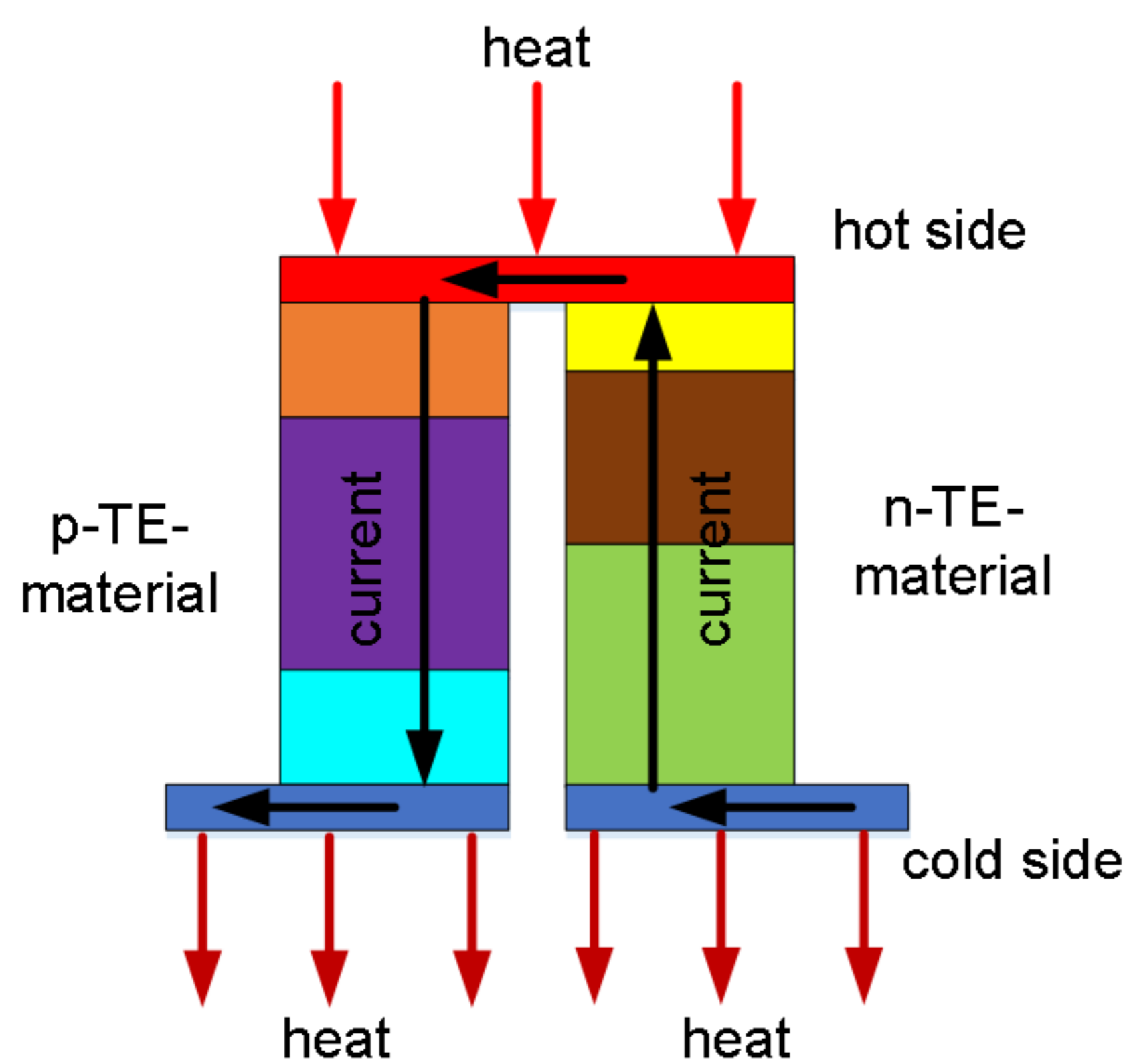


Figure 1. Typical element of TEM

**Computational Methods:** The TEM Comsol<sup>®</sup> model basically consists of the heat transfer in solids, heat transfer in thin shells, surface-to-surface radiation as well as non-isothermal turbulent flow of the air in order to fully understand the heat transfer in TEM.

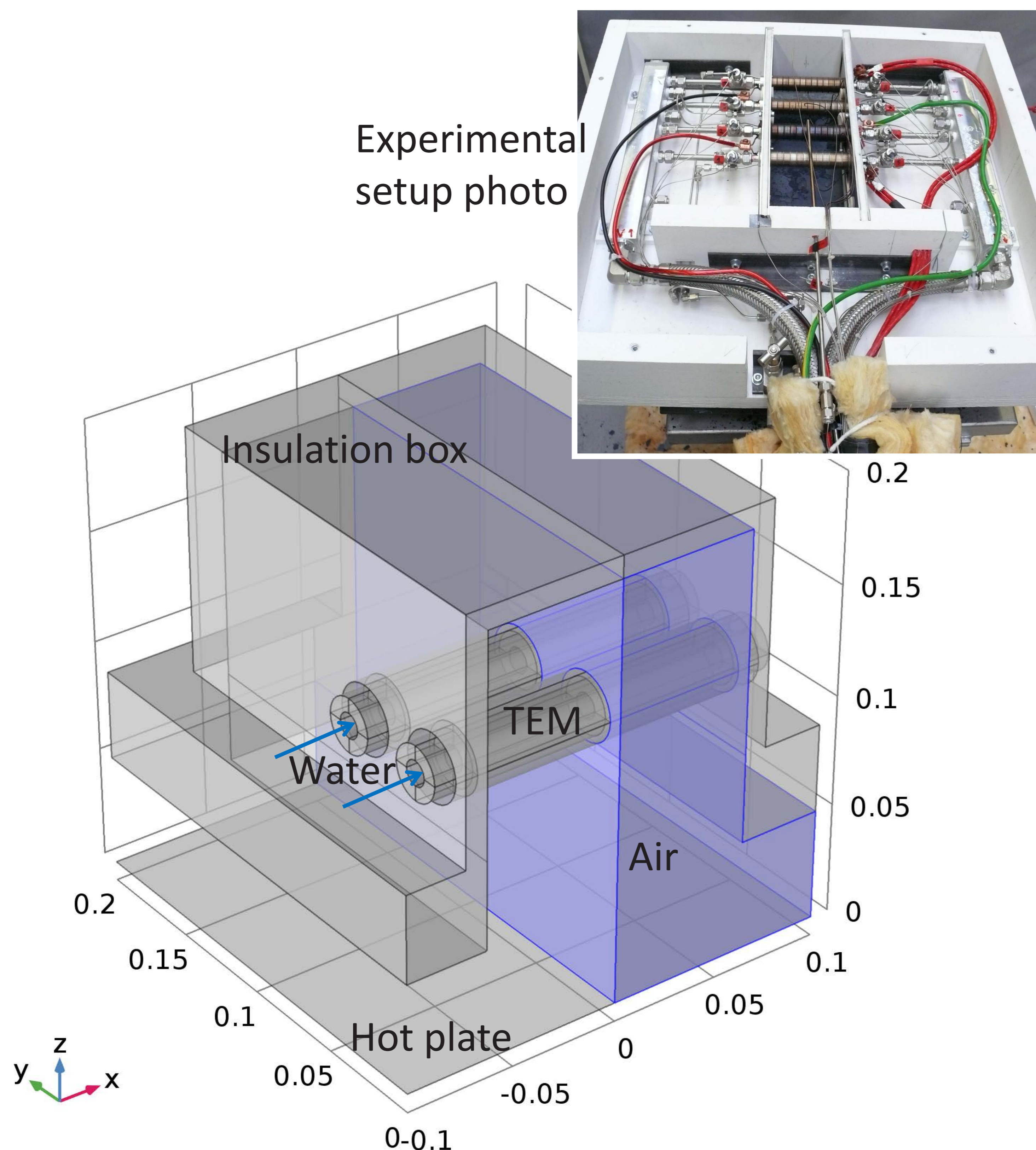


Figure 2. Model geometry and descriptions

**Results:** Influences of various configurations (given in Table 1) on the performance of TEMs are investigated. The distance to the hot plate, surface emissivity and closing the box top have the most contributions.

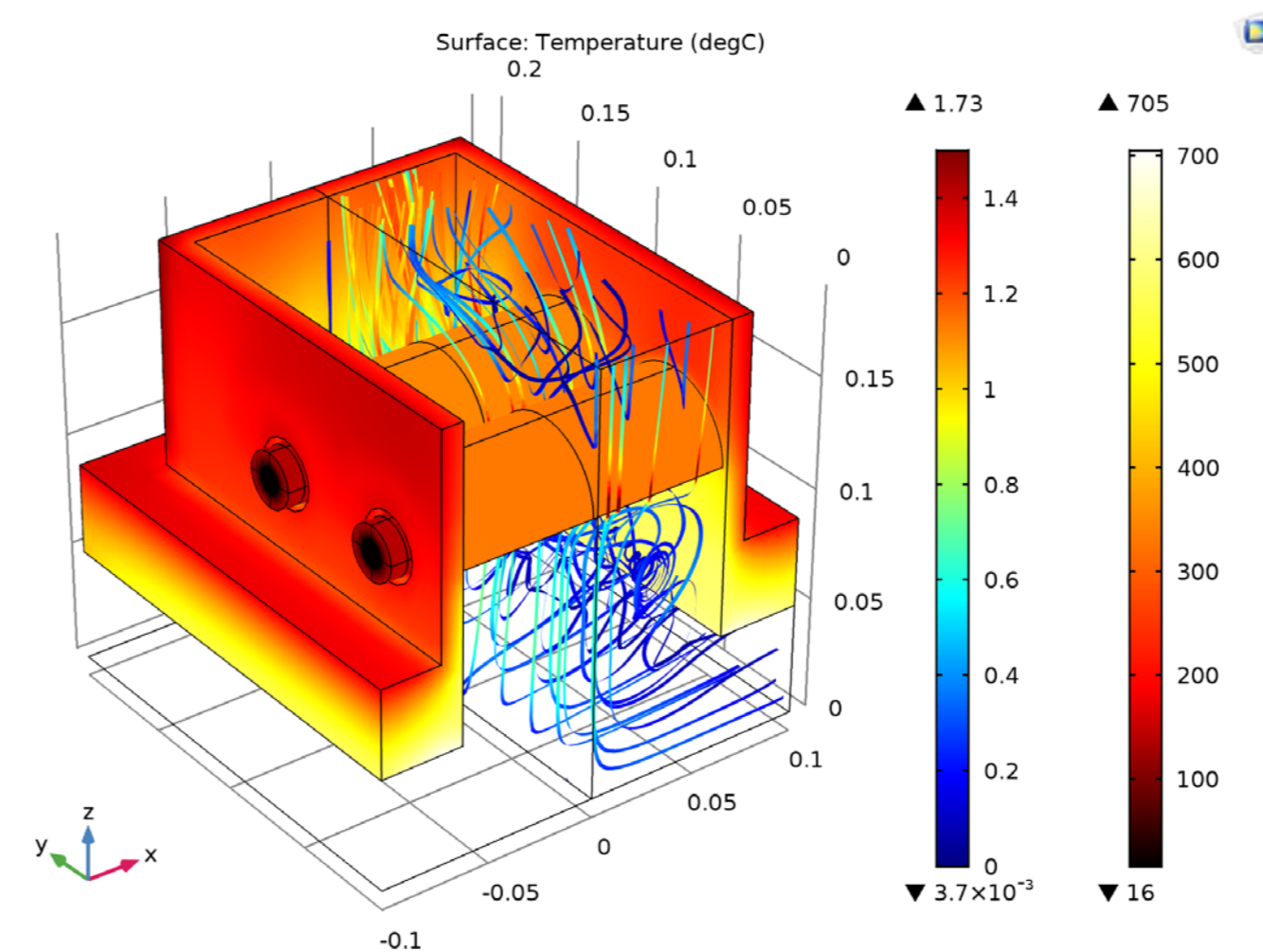


Figure 3. With reflector and open box-top

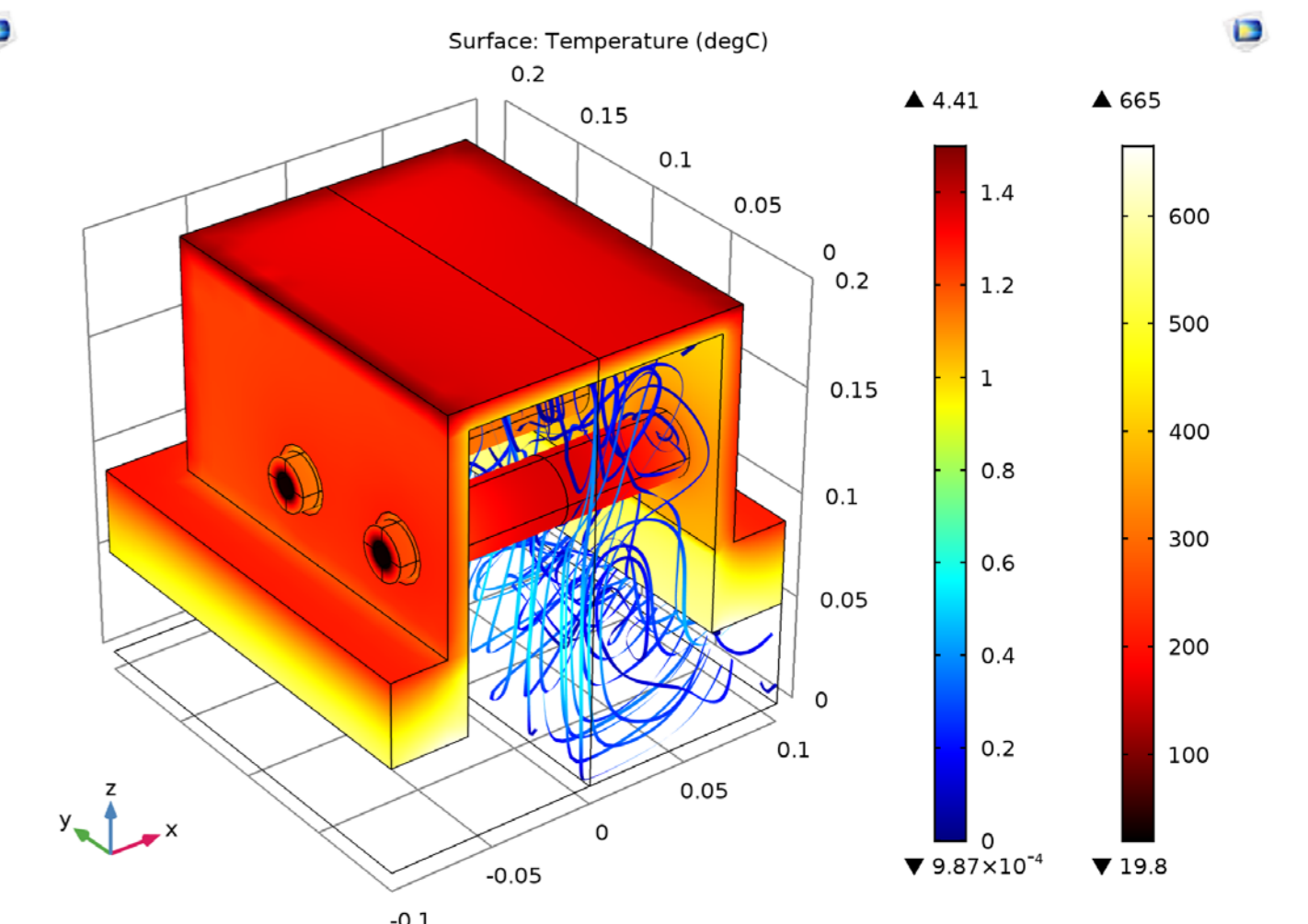


Figure 4. No reflector and closed box-top

	Sim1	Sim2	Sim3	Sim4	Sim5
reflector	yes	yes	yes	<b>no</b>	<b>no</b>
closed top	<b>no</b>	yes	yes	yes	yes
box height (mm)	178	178	178	<b>140</b>	<b>140</b>
TEG spacing (mm)	33	33	33	33	<b>10</b>
epsTEG1	0.2	0.2	0.2	0.2	0.2
epsTEG2	0.2	0.2	<b>0.9</b>	<b>0.9</b>	<b>0.9</b>

Table 1. Simulation configurations

	Sim1	Sim2	Sim3	Sim4	Sim5
Tmir1 (°C)	221.2	269.7	278.3	-	-
Tmir2 (°C)	246.0	300.9	319.9	-	-
Tteg1 (°C)	143.6	165.6	168.0	199.5	167.8
Tteg2 (°C)	148.3	172.7	271.4	316.3	297.0
Tair (°C)	200.9	313.2	319.2	455.5	455.2
<b>Qw TEG1 (W)</b>	<b>-257</b>	<b>-300</b>	<b>-305</b>	<b>-367</b>	<b>-346</b>
<b>Qw TEG2 (W)</b>	<b>-268</b>	<b>-316</b>	<b>-485</b>	<b>-571</b>	<b>-585</b>
Qw_conv1 (W)	25	38	41	41	41
Qw_conv2 (W)	20	31	13	7	14
Qhtr_conv (W)	-1016	-1022	-1028	-976	-1045
Qhtr_rad (W)	5239	5239	5239	5239	5239

Table 2. Computed temperatures and heat fluxes

	Tmir (°C)	Tteg1 (°C)	Tteg2 (°C)	Tair (°C)
M2: with reflector, box open	353.8	278.3	283.2	283.6
M3: with reflector, box closed	485.3	309.3	324.3	526.5
M4: with reflector, box closed	448.1	264.7	265.6	506.9
M5: with reflector, box closed	428.4	293.1	281.3	499.0
M6: with reflector, box closed	484.2	314.8	305.1	569.3
M7: no reflector, box closed	-	310.0	299.2	490.6

Table 3. Experimentally measured temperatures

**Conclusions:** As long as the top box is closed, the reflectors have negligible contribution. Additionally, TEMs should be coated to increase the emissivity and the distance to the hot plate should be optimized. Convection ribs on the TEMs have negligible contribution here.