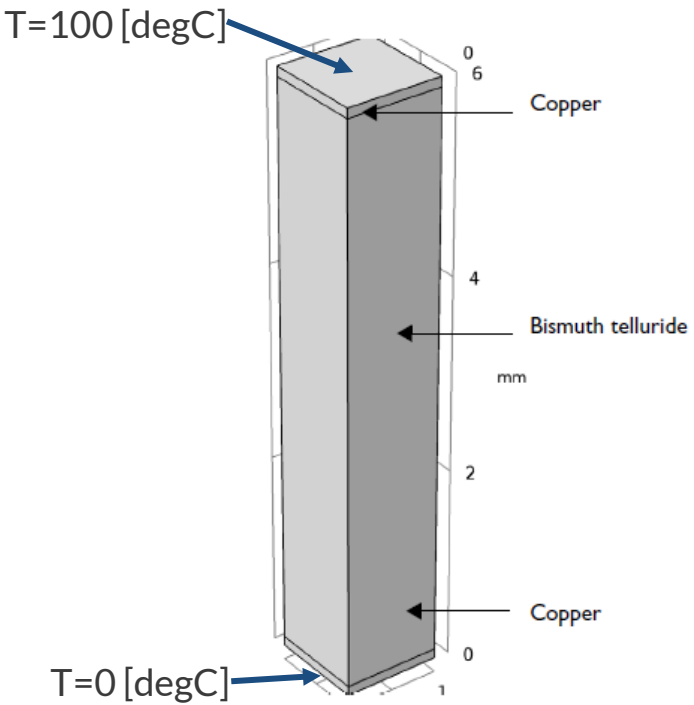
Thermoelectric generator

Objective

- Thermoelectric effect could work both ways:
  - Difference in temperature of a material leading to potential difference which is also known as Seebeck effect. The application lies as electric generator.
  - Difference in potential leading to temperature difference. The application lies in cooling purpose.
- This model is targeted to model Seebeck effect and works as a thermoelectric generator

Ref [1]: Multiphysics Simulation of Thermoelectric Systems - Modeling of Peltier-Cooling and Thermoelectric Generation, M. Jaegle, COMSOL Conference 2008 Hannover

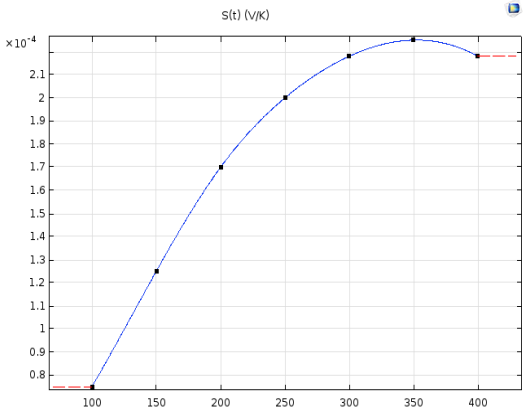
Model set up



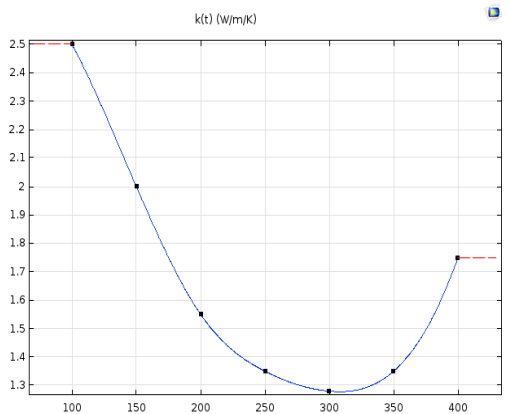
- As per the Example 3 of Jaegle M [1], we give 100[degC] at the top of the boundary of the electrode and 0[degC] at the bottom of the electrode.
- We use Floating potential boundary condition to draw a potential different of -22[mV] which matches good with Jaegle M [1] of -21[mV].

Material properties

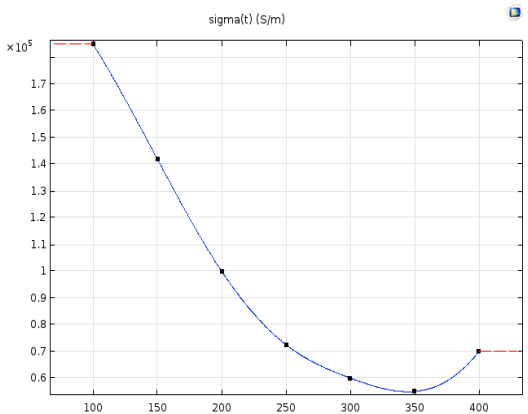
- The material properties for Bismuth Telluride - Bi2Te3 are the same as that of Jaegle M [1].
  - Heat capacity = 154.4[J/(kg*K)]
  - Density = 7740[kg/m^3]
  - Relative permittivity = 1



Seebeck coefficient



Thermal conductivity



Electrical conductivity

Material property (contd.)

- The Copper material was added from the Material library.
- Seebeck coefficient for copper was used as 6.5e-6[V/K]

Property	Variable	Expression	Unit
Relative permeability	mur ; mu...	1	1
Electrical conductivity	sigma ; si...	5.998e7[S/m]	S/m
Coefficient of thermal expansion	alpha ; al...	17e-6[1/K]	1/K
Heat capacity at constant pressure	Cp	385[J/(kg*K)]	J/(kg·K)
Relative permittivity	epsilonr ;...	1	1
Density	rho	8960[kg/m^3]	kg/m³
Thermal conductivity	k ; kii = k...	400[W/(m*K)]	W/(m·K)
Seebeck coefficient	S ; Sii =...	6.5e-6[V/K]	V/K

Results

- Global evaluation of floating potential gives 22[mV] which matches well with with Jaegle M [1] of -21[mV].