Flame Temperature

This example demonstrates calculation of the adiabatic flame temperature for a methane/air mixture, comparing calculations which assume either complete or incomplete combustion.

In [1]:

```
%matplotlib notebook
import cantera as ct
import numpy as np
import matplotlib.pyplot as plt
```

Complete Combustion

The stoichiometric equation for complete combustion of a lean methane/air mixture ($\phi < 1$) is:

$$\phi \mathrm{CH_4} + 2(\mathrm{O_2} + 3.76\mathrm{N_2}) \rightarrow \phi \mathrm{CO_2} + 2\phi \mathrm{H_2O} + 2(1-\phi)\mathrm{O_2} + 7.52\mathrm{N_2}$$

For a rich mixture ($\phi > 1$), this becomes:

$$\phi \mathrm{CH_4} + 2(\mathrm{O_2} + 3.76\mathrm{N_2}) \rightarrow \mathrm{CO_2} + 2\mathrm{H_2O} + (\phi - 1)\mathrm{CH_4} + 7.52\mathrm{N_2}$$

To find the flame temperature resulting from these reactions using Cantera, we create a gas object containing only the species in the above stoichiometric equations, and then use the `equilibrate()` function to find the resulting mixture composition and temperature, taking advantage of the fact that equilibrium will strongly favor conversion of the fuel molecule.

In [2]:

```
# Get all of the Species objects defined in the GRI 3.0 mechanism
species = {S.name: S for S in ct.Species.listFromFile('gri30.cti')}

# Create an IdealGas object with species representing complete combustion
complete_species = [species[S] for S in ('CH4','O2','N2','CO2','H2O')]
gas1 = ct.Solution(thermo='IdealGas', species=complete_species)

phi = np.linspace(0.5, 2.0, 100)
T_complete = np.zeros(phi.shape)
for i in range(len(phi)):
    gas1.TP = 300, ct.one_atm
    gas1.set_equivalence_ratio(phi[i], 'CH4', 'O2:1, N2:3.76')
    gas1.equilibrate('HP')
    T_complete[i] = gas1.T
```