Reactions for Energy

Equilibrium Reaction Thermodynamics

Prof. Asish K Sarangi

Dept. of Energy Science and Engineering

IIT BOMBAY

Learning objectives

- Determine how much heat would be liberated during a reaction

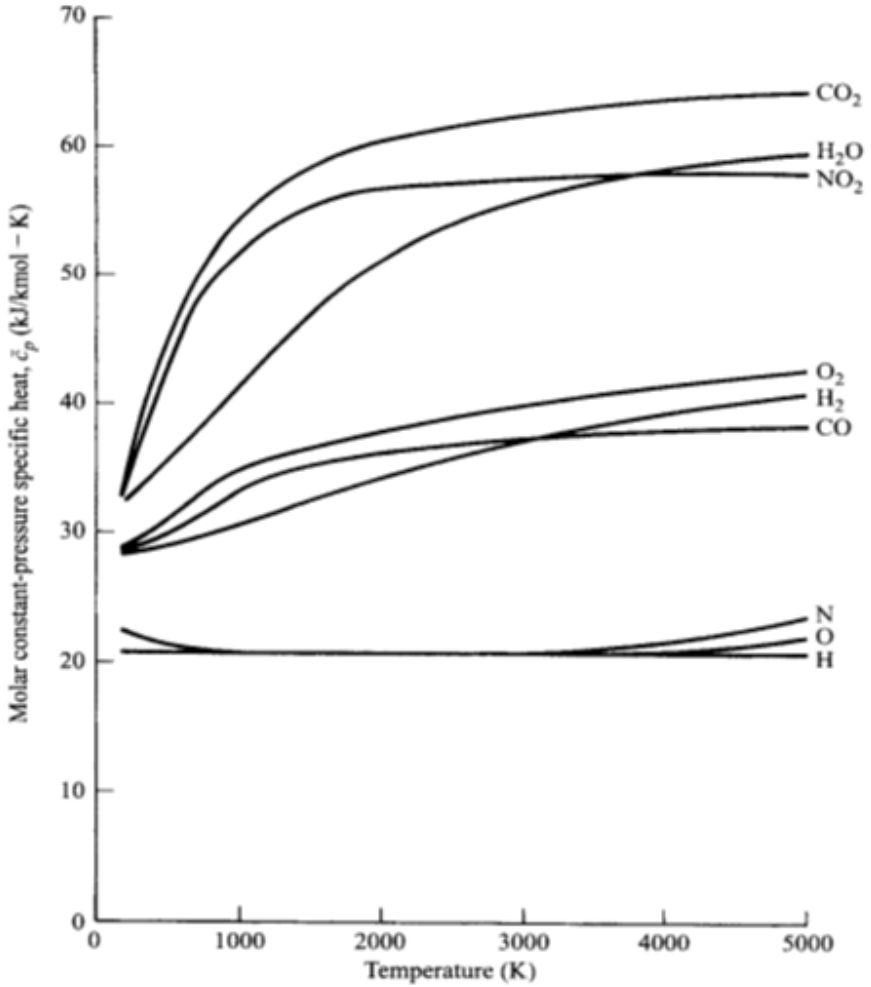
Equilibrium reaction thermodynamics

Assumptions:

- Chemical reactions occur between gases
- Reaction is homogeneous
- Gases obey ideal gas laws
- Chemical processes occur between thermodynamic equilibrium states
- Calorically perfect gas behavior

Review of Thermo-chemistry (1)

Heat capacities—specific heat at const volume and pressure



Review of Thermo-chemistry (2)

Ideal gas mixtures

Dalton's law of partial pressure

Partial pressure of the ith species, P_i, is the pressure of the ith species if it were isolated from the mixture at the same temperature and volume as the mixture.

Stoichiometry (1)

Stoichiometric air-fuel mixture:

It contains the exact amount of fuel and oxidizer such that after combustion is complete, all the fuel and oxidizer are consumed to form products and ??

Combustion Stoichiometry (2)

Fuel-air ratio

Equivalence ratio

Excess air ratio

Stoichiometry (3)

Example 1: Considering a stoichiometric mixture of iso-octane and air, determine:

(a) The mole fraction of fuel
(b) Fuel-air ratio
(c) Mole fraction of water in the products
(d) The temperature of products below which water vapour starts to condense into liquid at 101.325 kPa pressure.

Next Lecture

- **Enthalpy of reaction and enthalpy of formation**