

# Chemical Energetics

## Energetics of a Reaction

- **Exothermic reactions:** Release heat, total chemical energy of reactants is greater than products.
- **Endothermic reactions:** Absorb heat, total chemical energy of reactants is less than products.
- **Activation energy:** Minimum energy required for a reaction to occur.

## Bond Breaking and Bond Making

- **Bond breaking:** Endothermic process, energy is absorbed.
- **Bond making:** Exothermic process, energy is released.

## Energy Transfer

- **Common heat source:** Burning fossil fuels (natural gas, coal, petroleum).
- **Hydrogen as fuel:**
  - Highly exothermic combustion.
  - Advantages: energy-rich, no pollutants, no nitrogen oxides.
  - Disadvantages: expensive to produce and store.

## Hydrogen Fuel Cells

- **Electrochemical device:** Converts chemical energy into electrical energy.
- **Process:**
  - Hydrogen is oxidized at the anode.
  - Oxygen is reduced at the cathode.
  - Overall reaction:  $\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$
- **Advantages:** Efficient, clean, and produces water as a byproduct.

**Remember:**

- The enthalpy change ( $\Delta H$ ) is negative for exothermic reactions and positive for endothermic reactions.
- Bond enthalpies can be used to calculate the enthalpy change of a reaction.
- Energy diagrams can be used to visualize the energy changes during a reaction