

# Lecture 3: Ionization Techniques – Part II

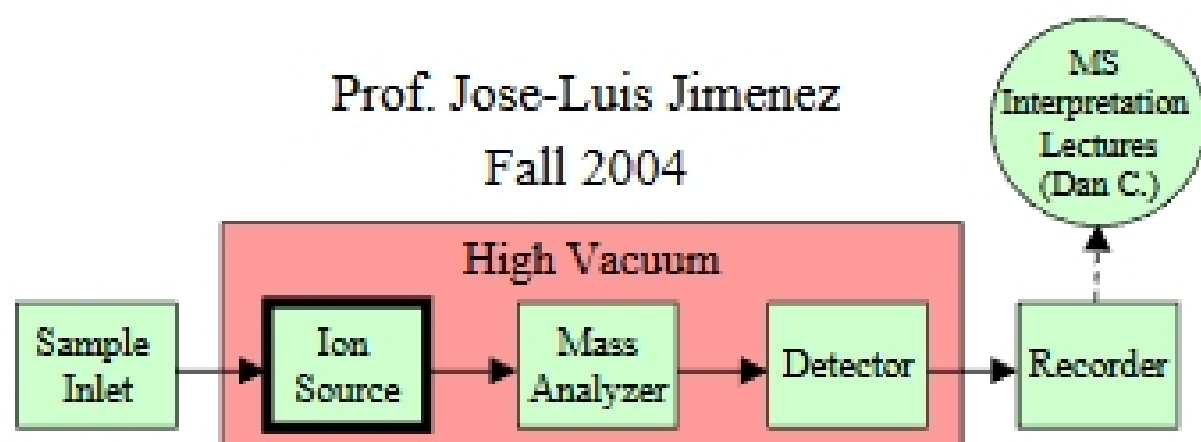
CU- Boulder

CHEM 5181

Mass Spectrometry & Chromatography

Prof. Jose-Luis Jimenez

Fall 2004



## More Ionization Methods Brainstorming

- What are the limitations of EI?
- Which other physical / chemical techniques can we use to produce ions?

## Ionization Techniques (Other than EI)

- **Ionization for Molecular Analysis**
  - **Chemical Ionization (CI)**
    - **Atmospheric Pressure CI (APCI)**
  - Spray Ionization
    - Thermospray
    - Electrospray
  - Desorption Ionization
    - Fast Atom Bombardment (FAB)
    - Matrix-Assisted Laser Desorption/Ionization (MALDI)
- Ionization for Elemental Analysis
  - Glow Discharge
  - Spark Source
  - Thermal Ionization Source
  - Inductively-Coupled Plasma (ICP-MS)

## Chemical Ionization

- Reaction of
  - Neutral analyte M
  - With ion
    - generated by high pressure EI
- Much more controllable than EI
  - Internal energy of molecular ion
    - Degree of fragmentation

## CI Reactions

---

- Charge exchange:  $M + Ar^+ \rightarrow M^+ + Ar$
- Electron capture:  $M + e^- \rightarrow M^-$
- Proton transfer:  $M + CH_5^+ \rightarrow (M+H)^+ + CH_4$
- Adduct formation:  $M + TiCl_2^+ \rightarrow (M+TiCl_2)^+$
  
- Need Collisions!
  - $\lambda \sim 0.1 \text{ mm}$  ( $P = 0.6 \text{ mbar}$ )

## Gas-Phase Ion-Molecule Reactions

---

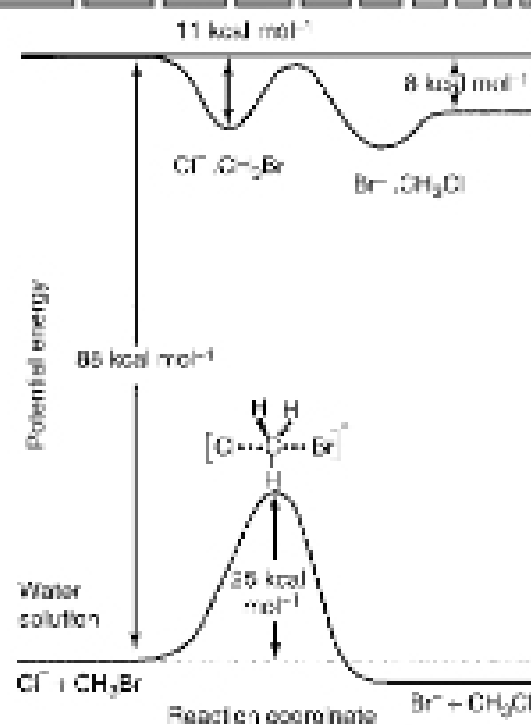
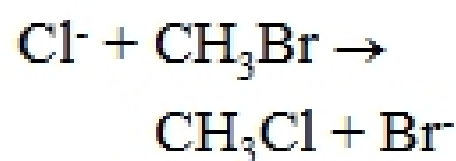


Figure 1.36  
Potential energy diagram for a substitution reaction in the gas phase and in solution in water.<sup>75</sup>