

Lecture 3: Ionization Techniques – Part II

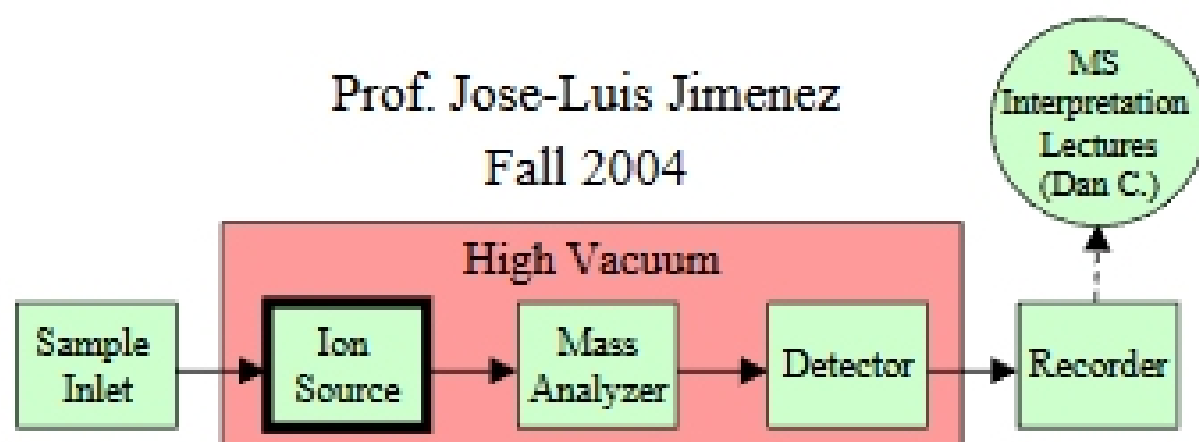
CU- Boulder

CHEM 5181

Mass Spectrometry & Chromatography

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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

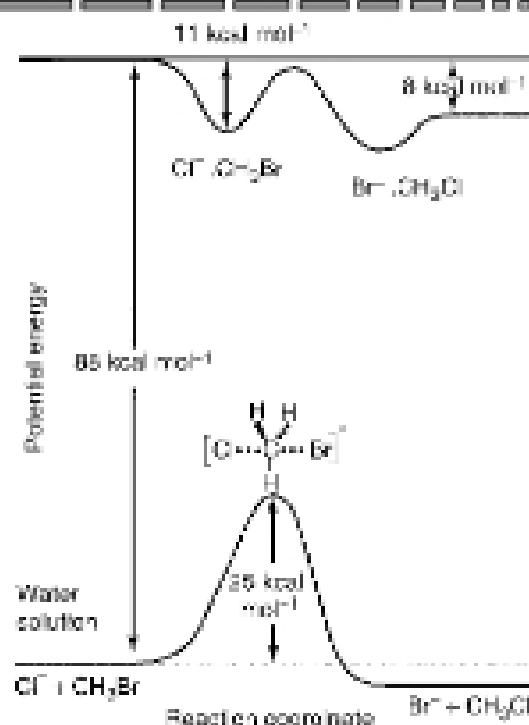
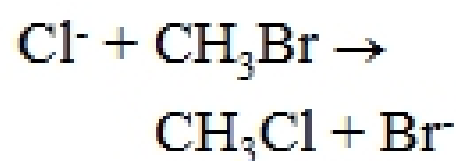


Figure L36
Potential energy diagram for a substitution reaction in the gas phase and in solution in water.⁷⁵

From Hoffmann