



Molecular Rectifiers

Seminar talk presented by

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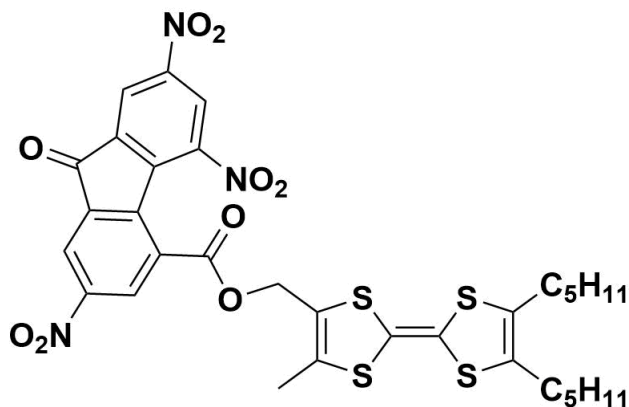
Molecular Rectifiers

1. History and basic principles
2. Prominent literature examples
3. Work in the Schreiner's group
4. Future planes

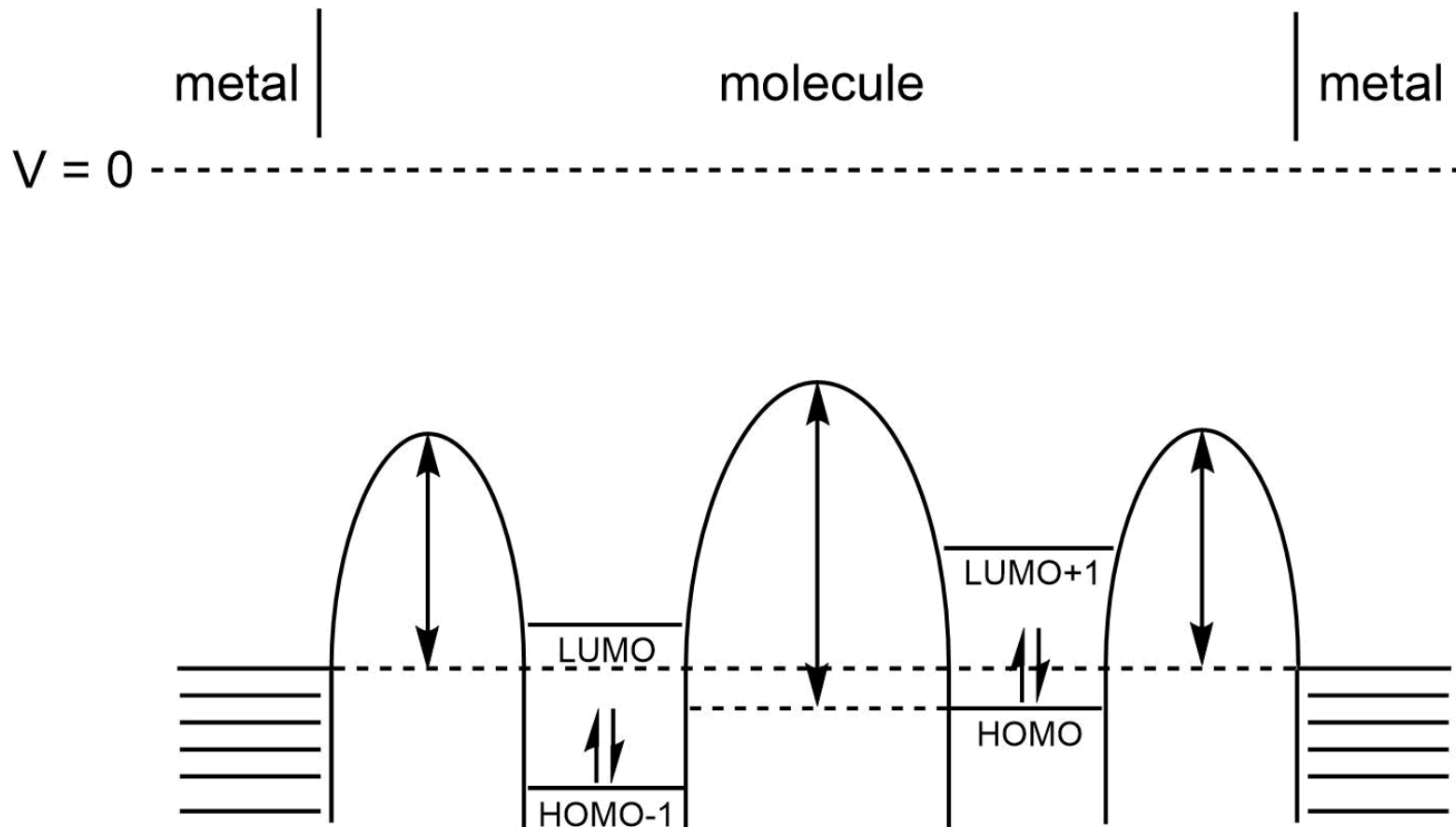
History and basic principles



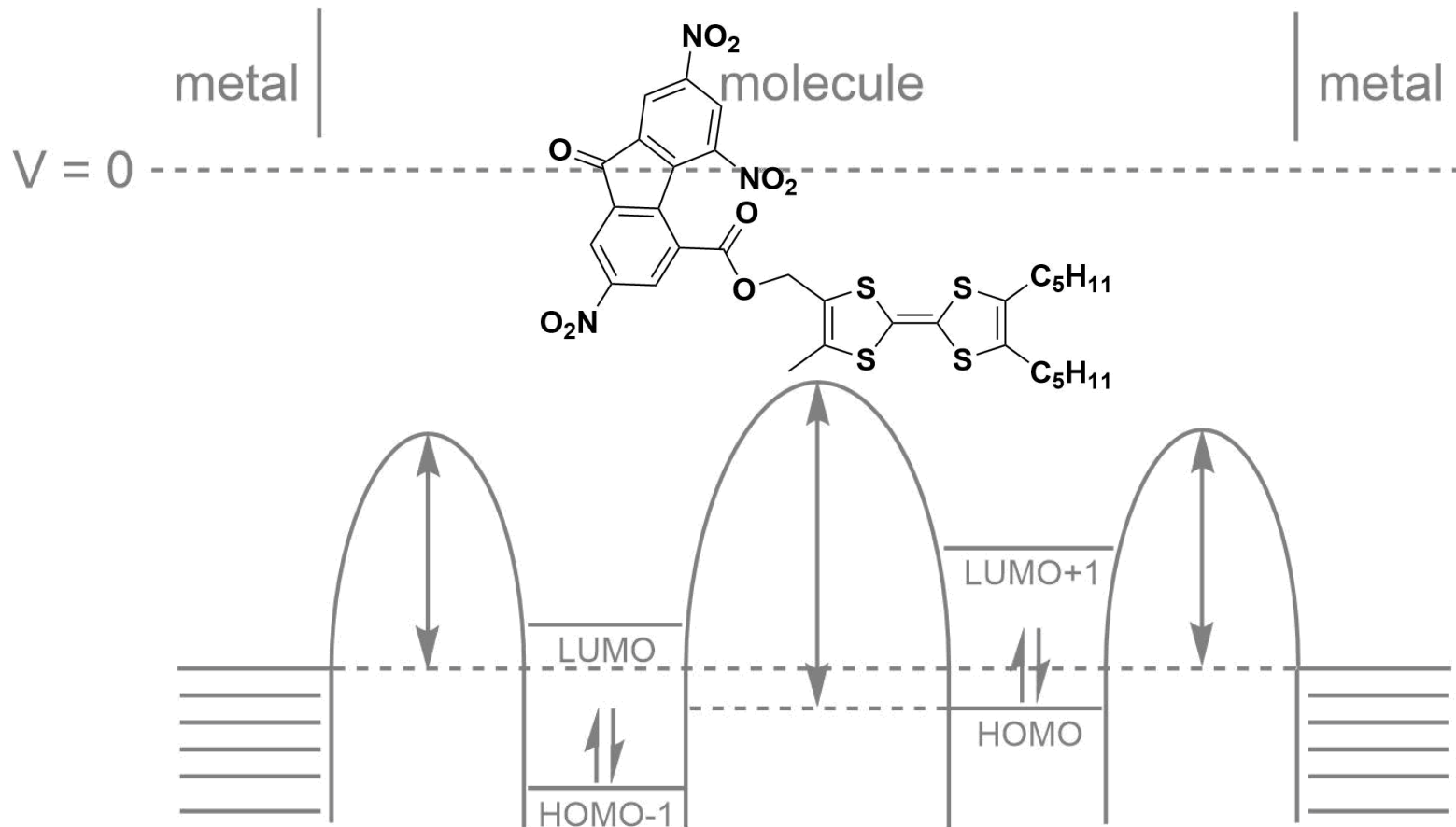
- Original idea proposed by Aviram and Ratner in 1974
- Molecular rectifiers should be composed of a separated electron donor and acceptor pair
- The molecule can be seen as two separate ones which interact by tunneling



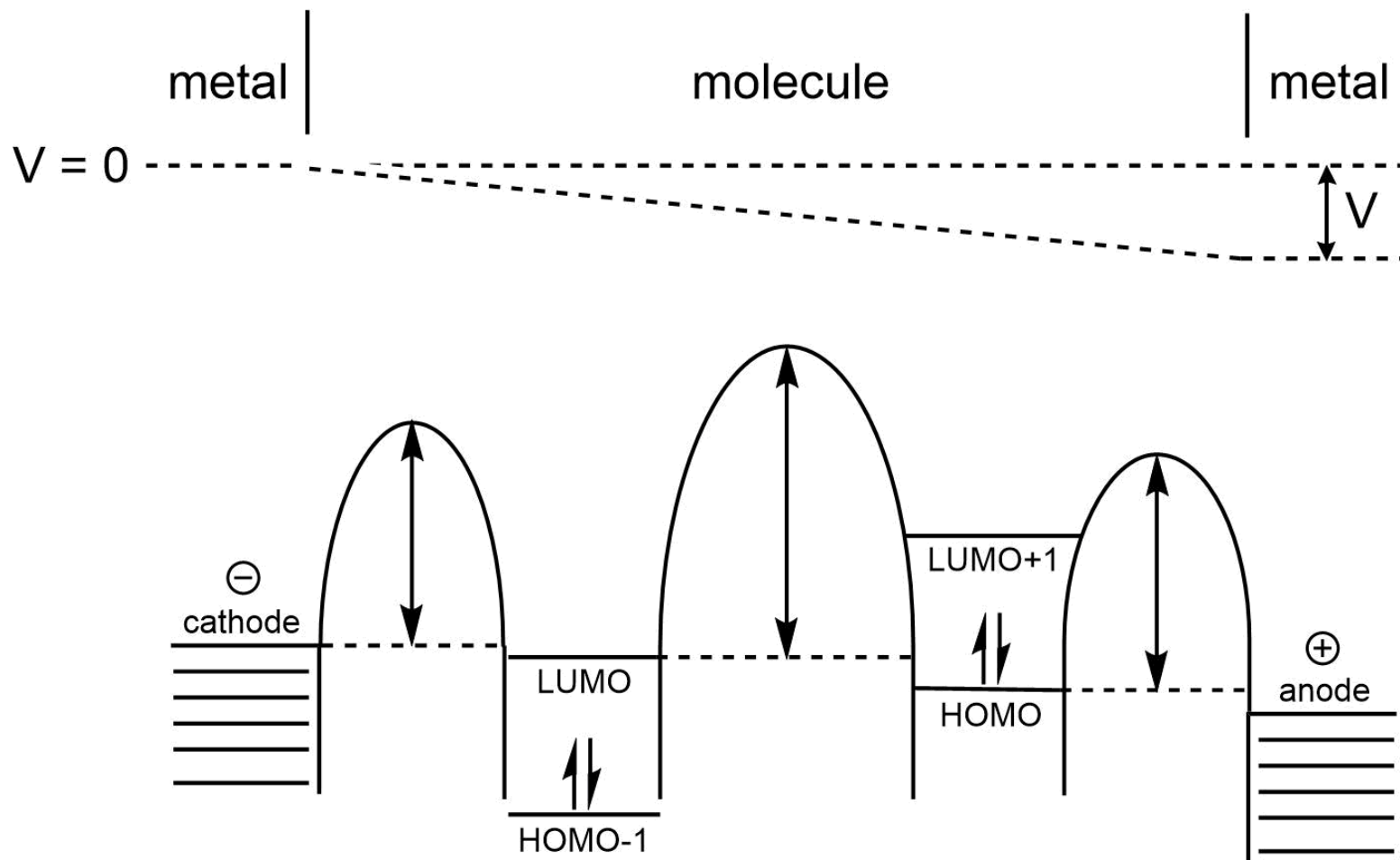
History and basic principles



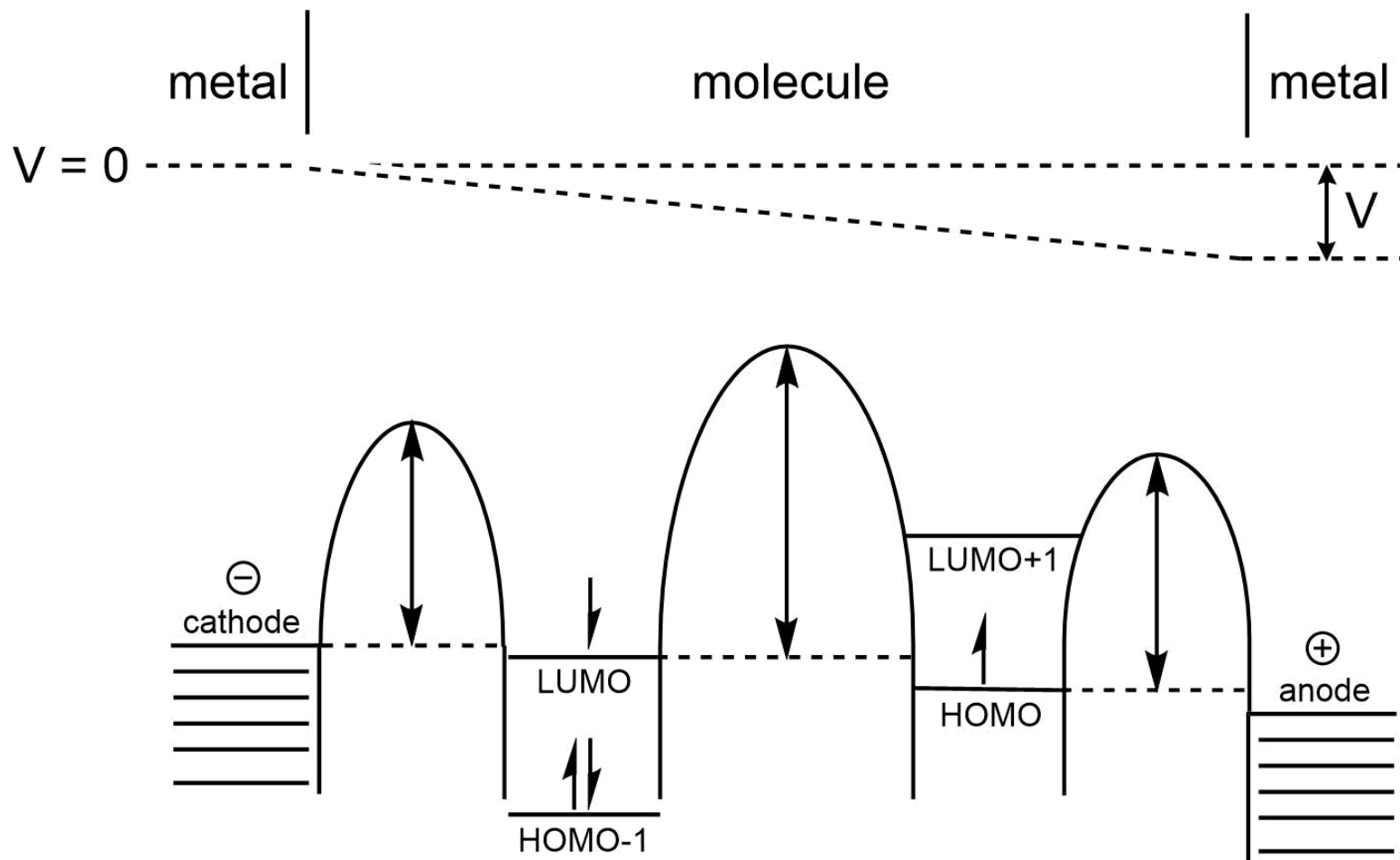
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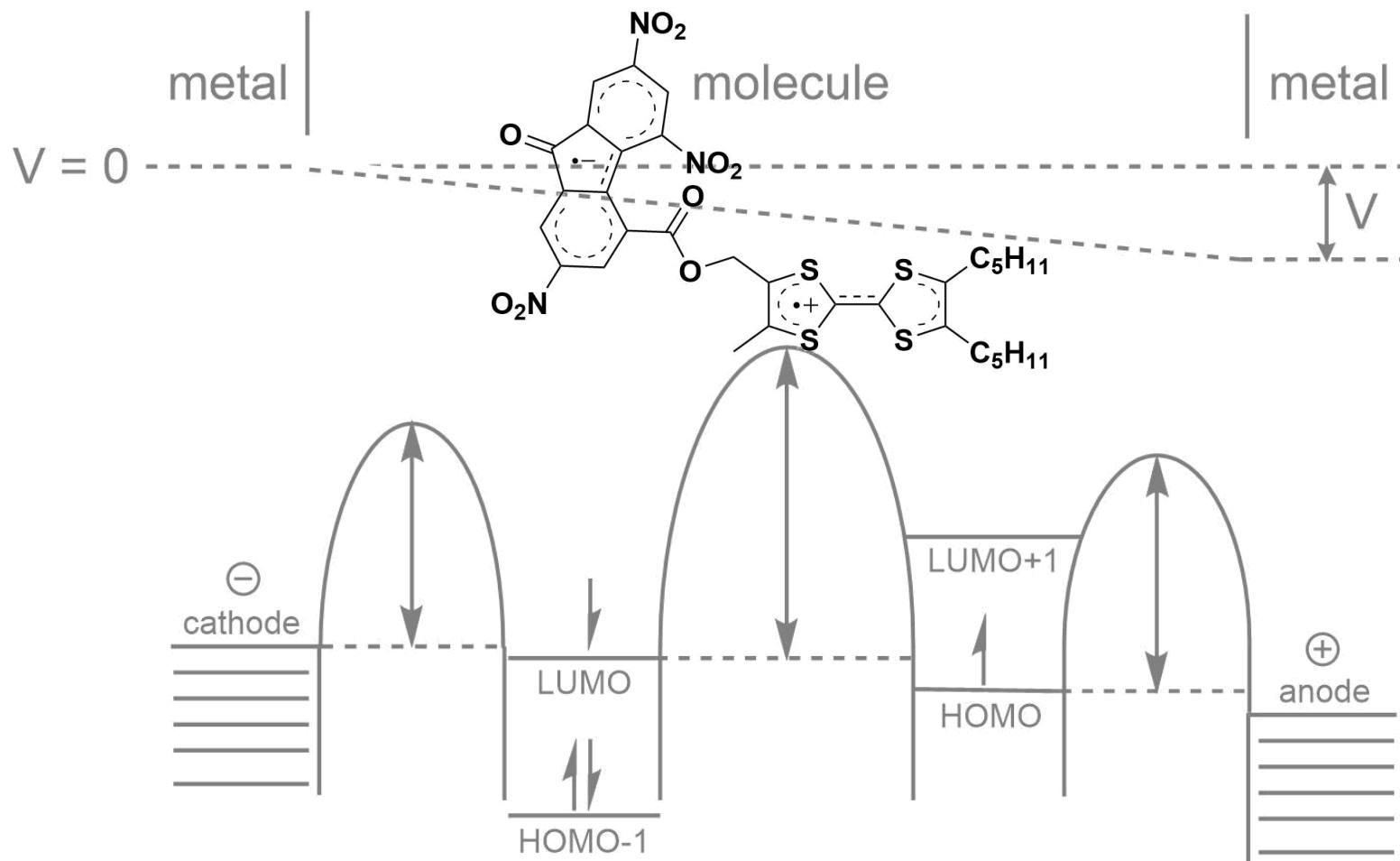
History and basic principles



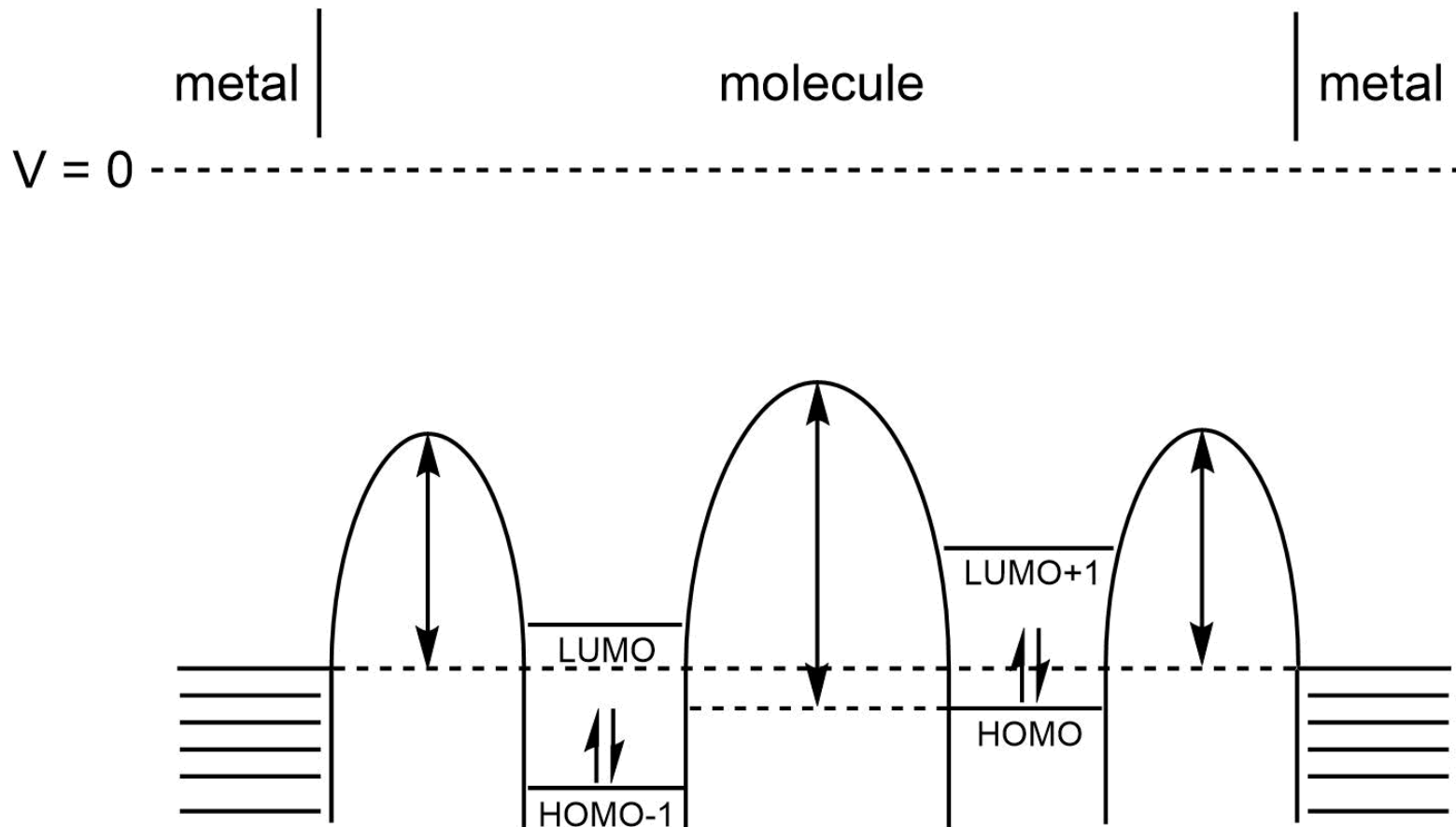
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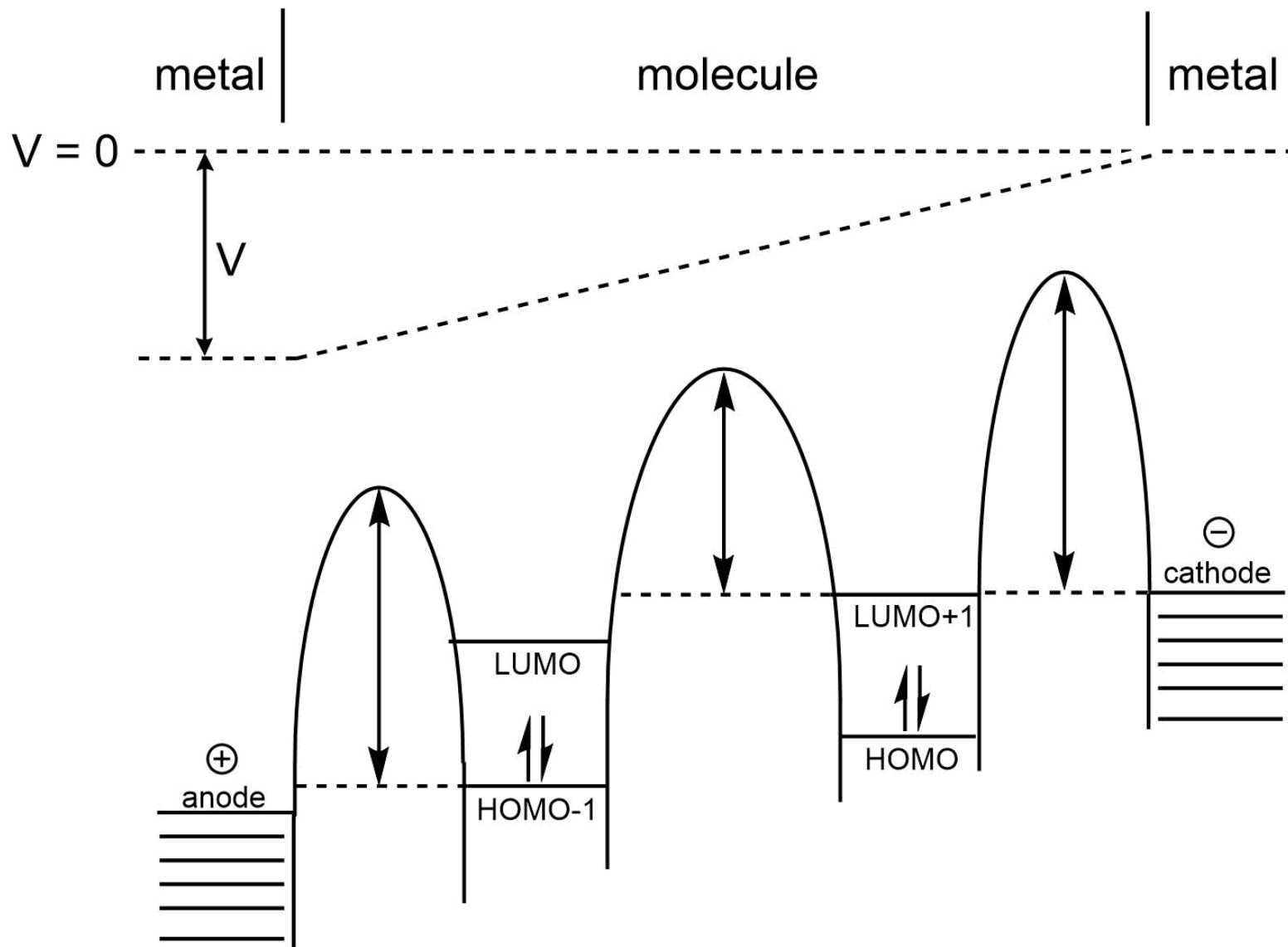
History and basic principles



History and basic principles



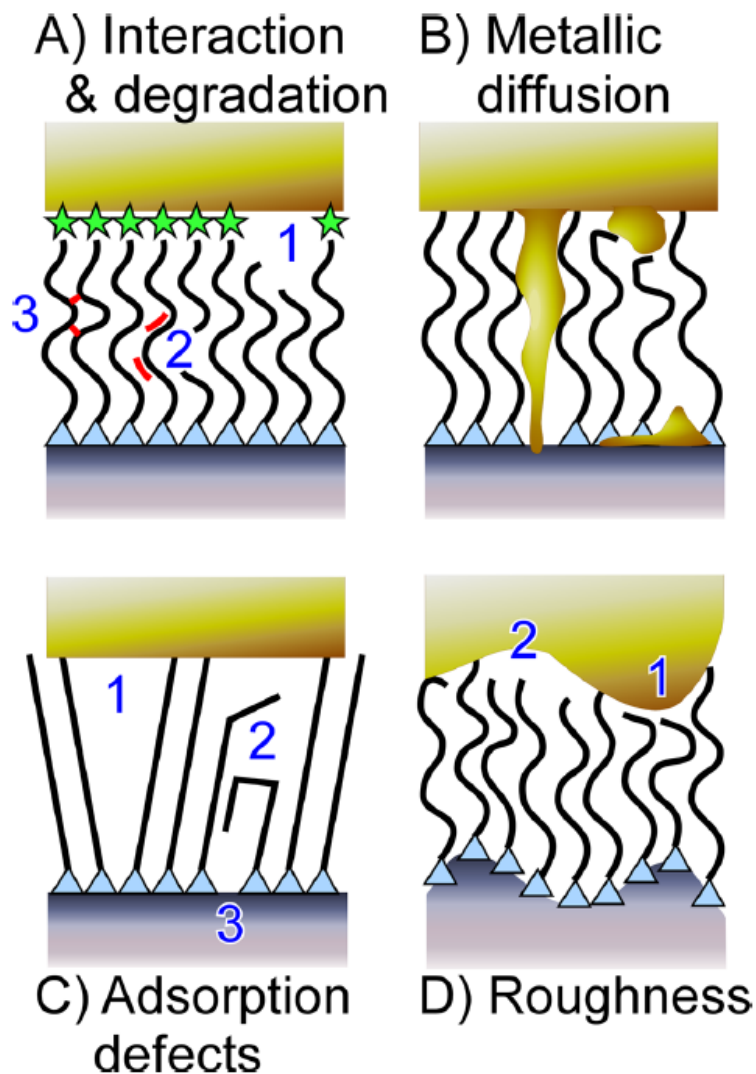
History and basic principles



History and basic principles



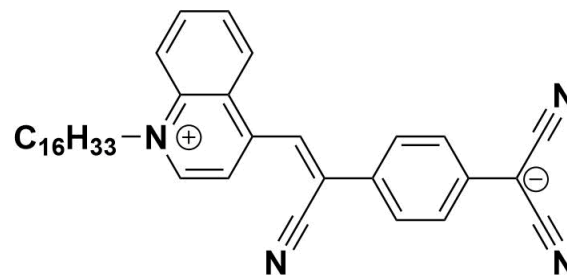
- Molecules are assembled on the surface as a single or several monolayers
- A top contact has to be added with care
- Defects strongly influence performance
- Control is very difficult



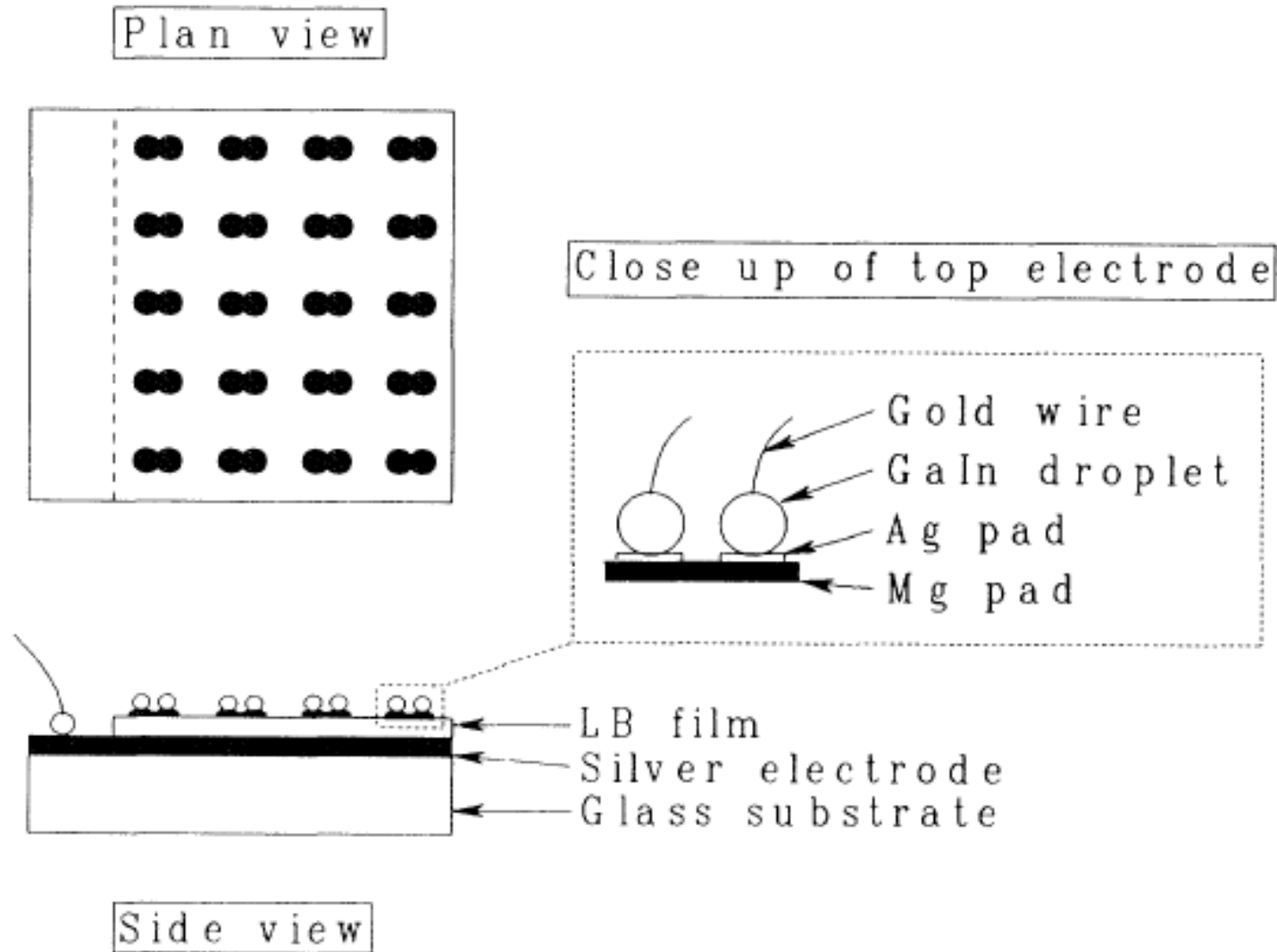
History and basic principles



- Best investigated rectifier so far
- Distortion of the π -system results in separation of donor and acceptor
- Several experiments were necessary to establish the electric properties



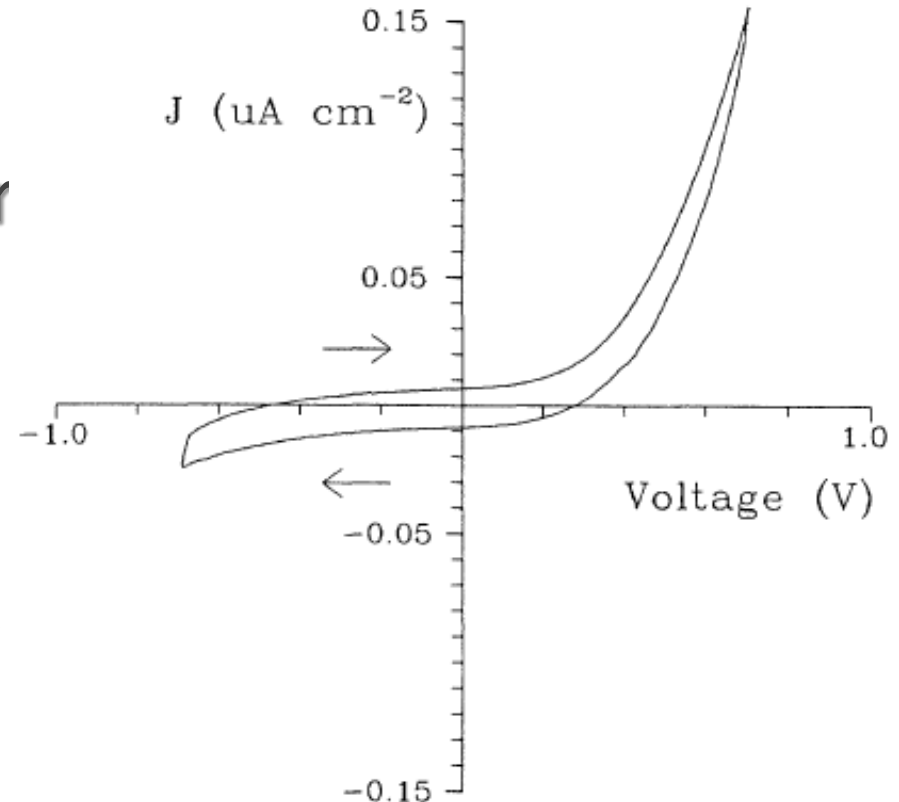
History and basic principles



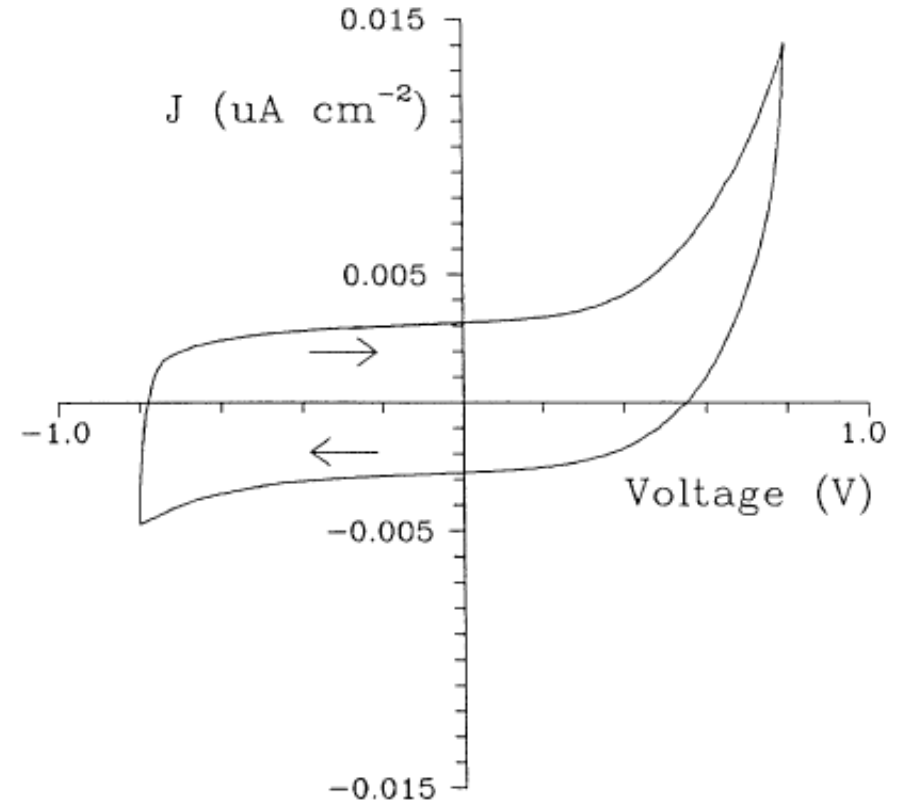
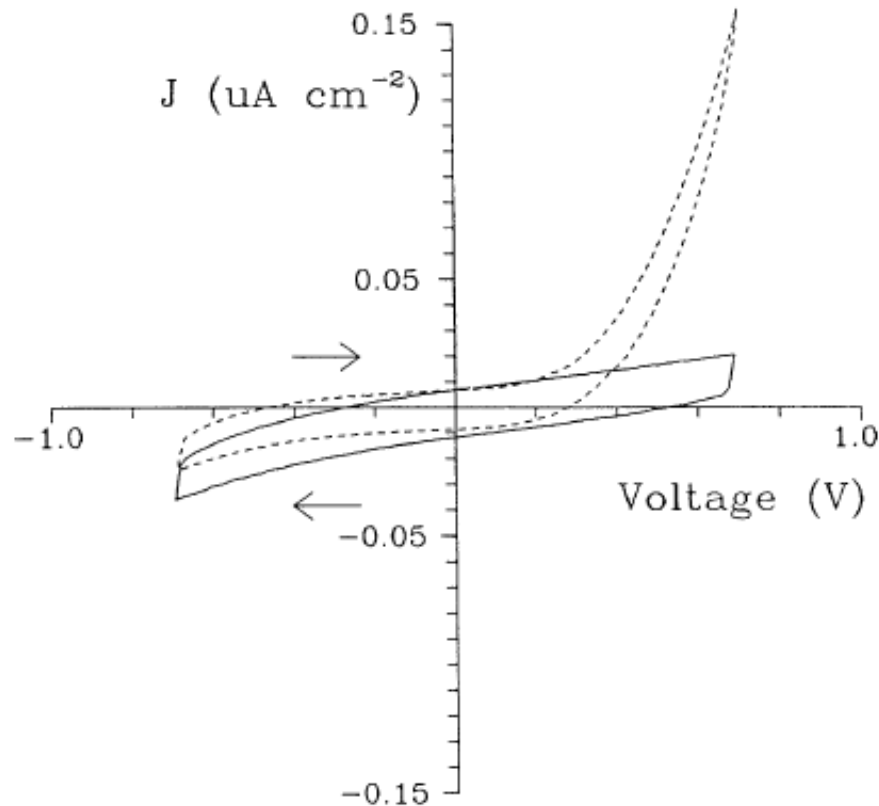
History and basic principles



- Rectification was shown early on, but the nature was unclear
- To verify molecules were assembled between additional layers of ω -tricosenoic acid



History and basic principles

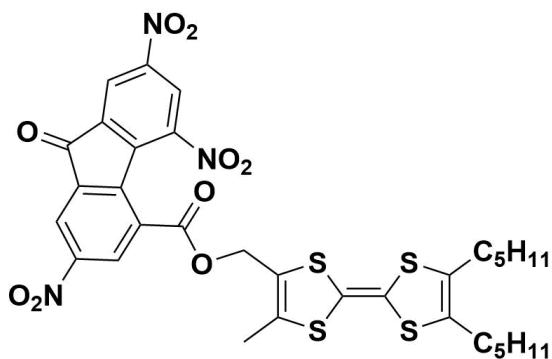


→ Rectification is a molecular property

Prominent examples from literature



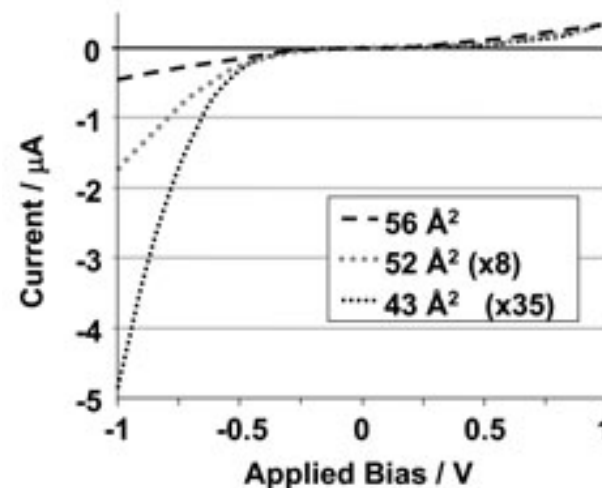
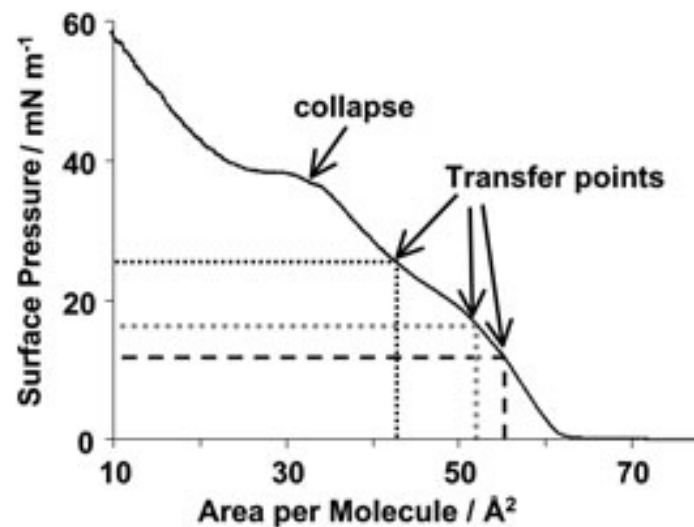
- The combination of fluorenone and a tetrathiofulvalene linked together
- Classic assembly proposed by Aviram and Ratner
- Low HOMO-LUMO gap of 0.3 eV



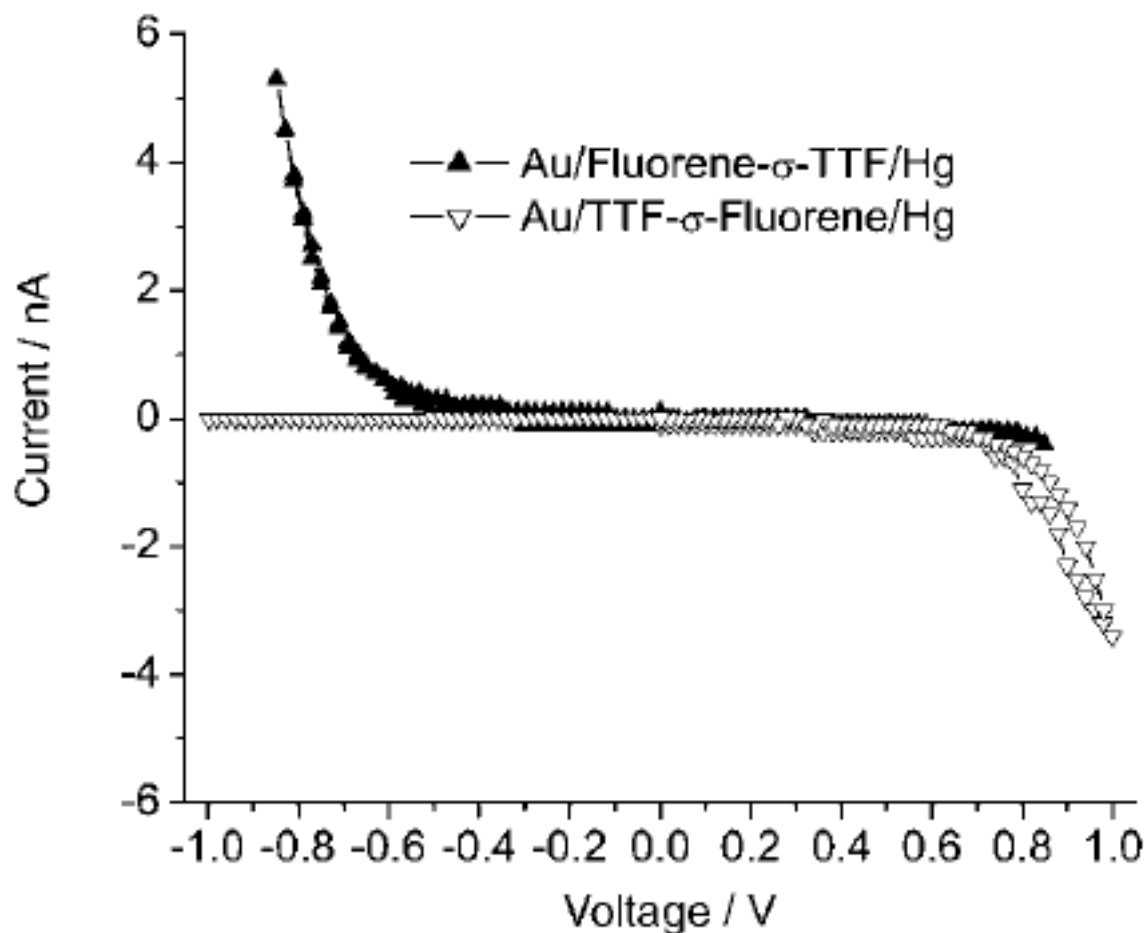
Prominent examples from literature



- Monolayers assembly by Langmuir-Blodgett trough
- Three structurally different alignments
- Rectification and conduction properties greatly differ as well



Prominent examples from literature

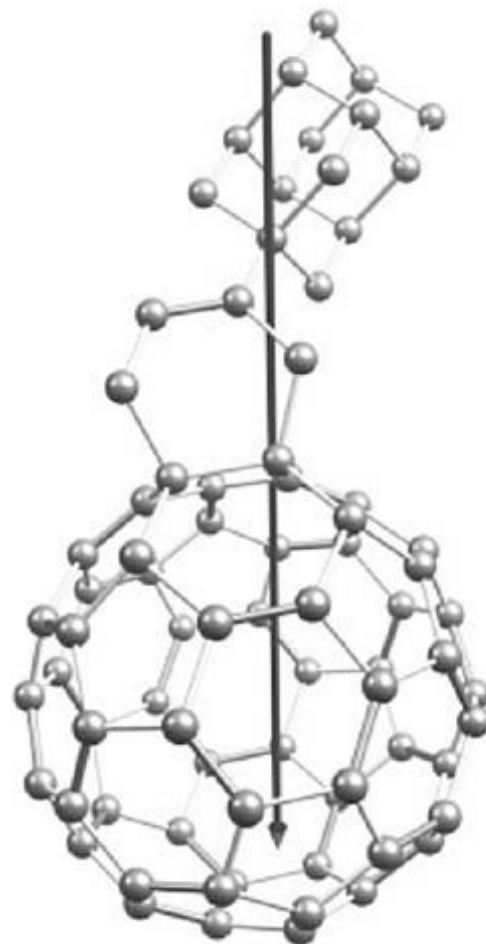


Actual molecular rectification

Schreiner's group



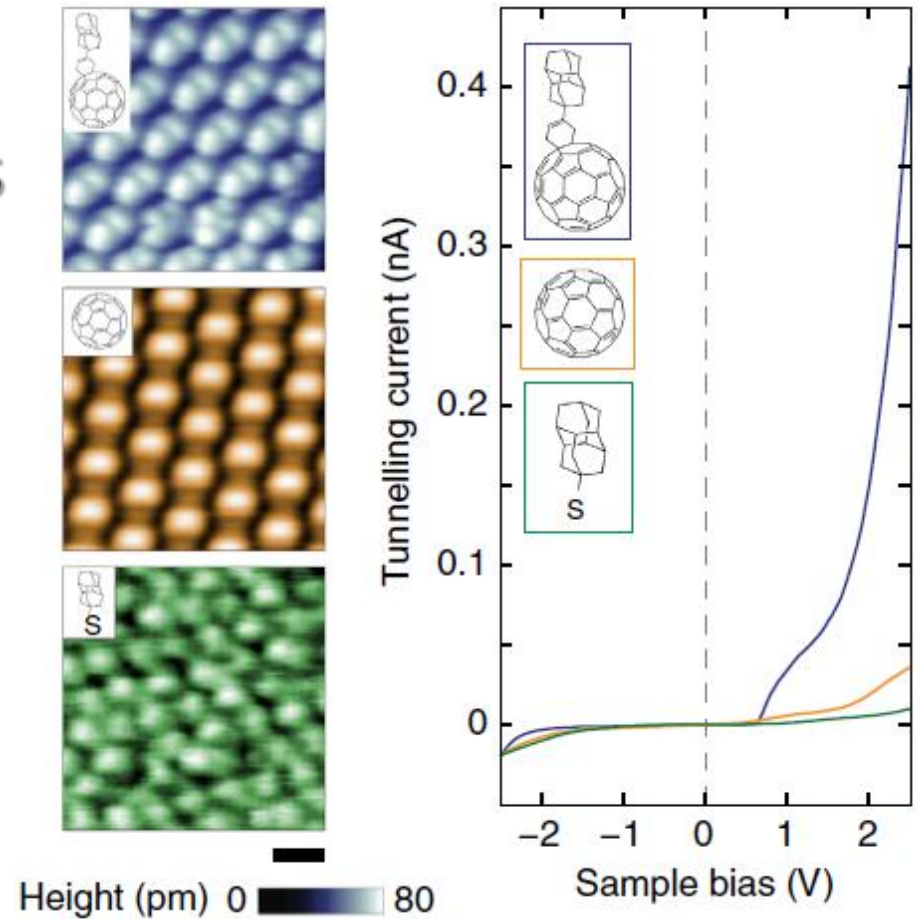
- Fullerenes tend to form suitable monolayers
- Fullerene and adamantane show promising orbital interactions
- Both are fused by means of a Diels-Alder-reaction



Schreiner's group



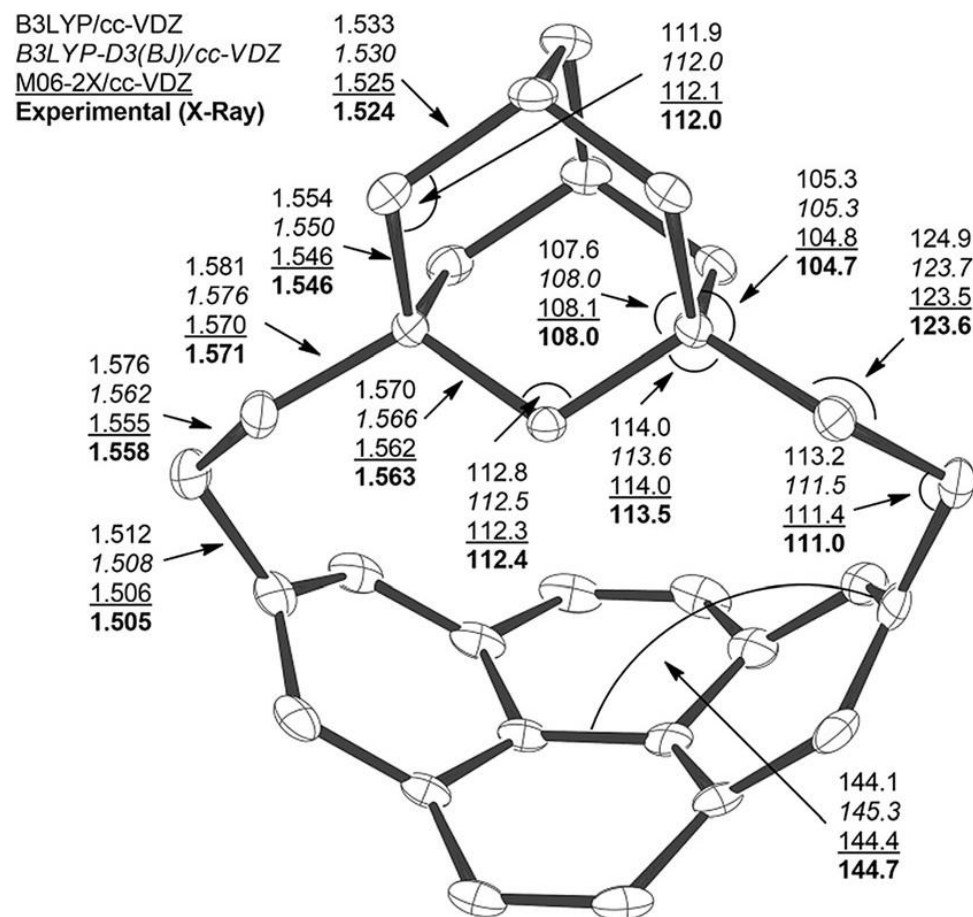
- The molecules shows the desired properties
- Still it is thermally unstable and the coverage is in need of improvement



Schreiner's group



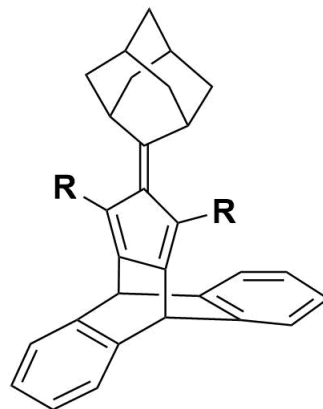
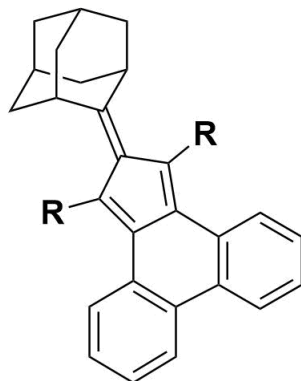
- Successor molecule is designed and synthesized
- Still it is not tested as a monolayer on a surface



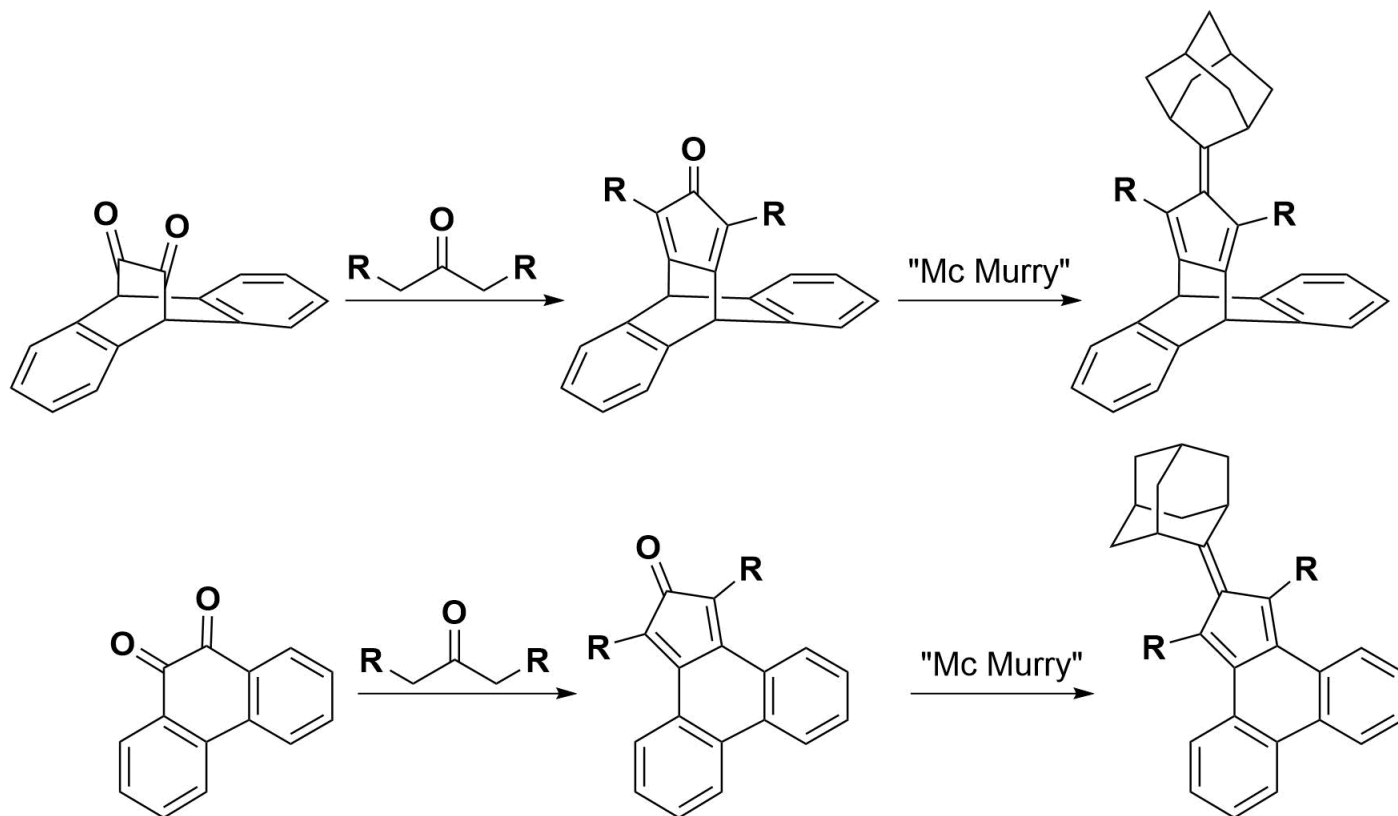
Future planes



- Both molecules still are not suitable for long-term studies
- The aim is so find structures that are
 - simple to synthesize
 - easily derivatized
 - still combine donor and acceptor



Future planes





Thank you for
your kind attention!