Investigation of the growth of terephthalic and benzoic acids on Au(111) and Aluminum

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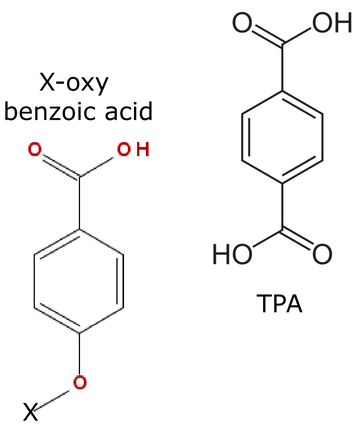
Motivation

The adsorption behavior of benzoic acids on metal interfaces is of high interest for metal-substrat interactions for catalysis and the construction of metal-organic frameworks. Here we present our results on the growth of thin films of 4-R-benzoic acid (R stands for hydroxyl-, methoxy-, propoxy-, pentoxy- and decyloxy-chains) and terephthalic acid (TPA) on Au(111) and oxidized aluminum. The adsorption was studied with metastable induced electron spectroscopy (MIES) and ultraviolet photoelectron spectroscopy (UPS(HeI)). For the monolayer on Au(111) we find hints for a flat orientation of the molecules. For the growth on an oxidized aluminum foil we suppose a more upstanding arrangement. The TPA molecules show a similar growth behavior for both surfaces.

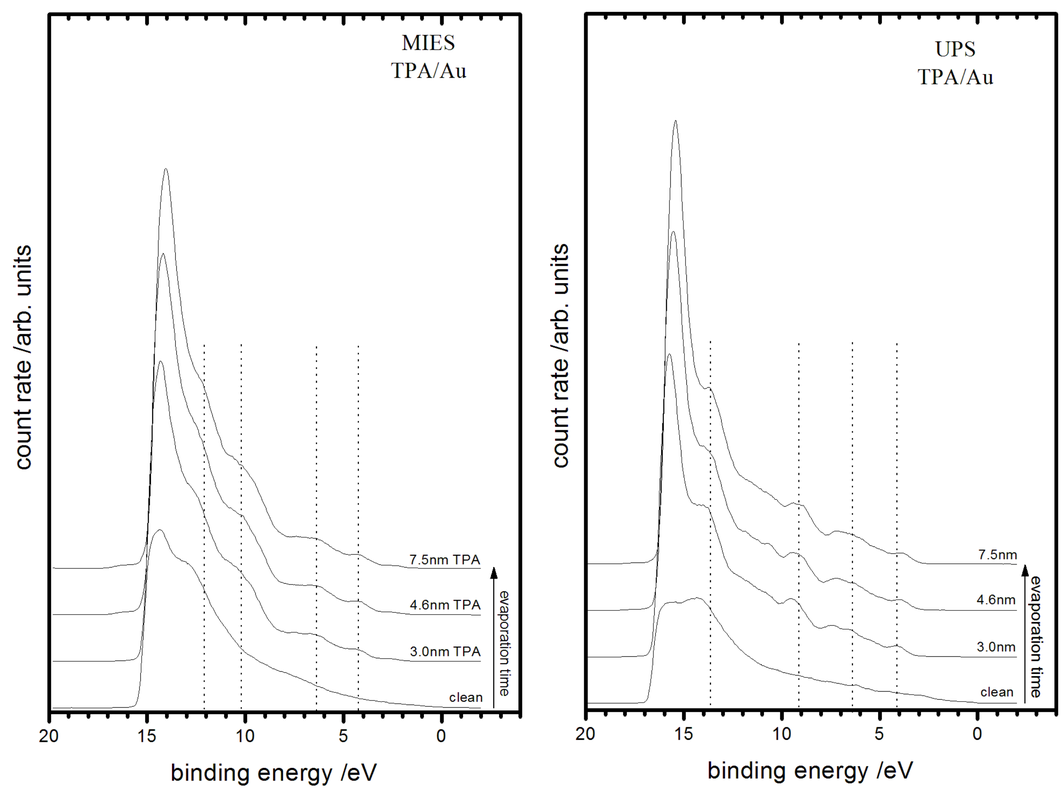
Experimental

UPS: He I (21.2 eV)
MIES: He* 2^3S_1 (19.8 eV)
UHV systems with base pressure < 2.0×10^{-10} Torr
Substrate: **Au(111), Alumnium foil**

The sample surfaces were prepared by vapour deposition of the ultrapure benzoic acid on an Au(111) substrate and the Al foil.

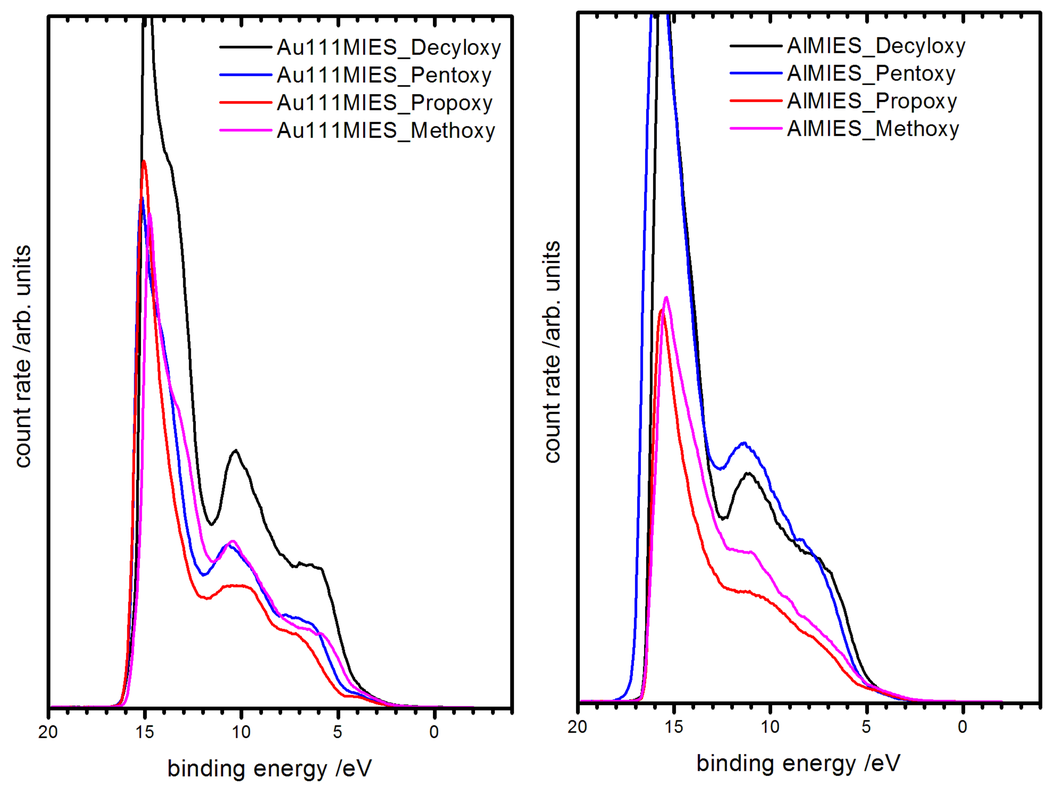


Spectra of thin films TPA on Au(111)



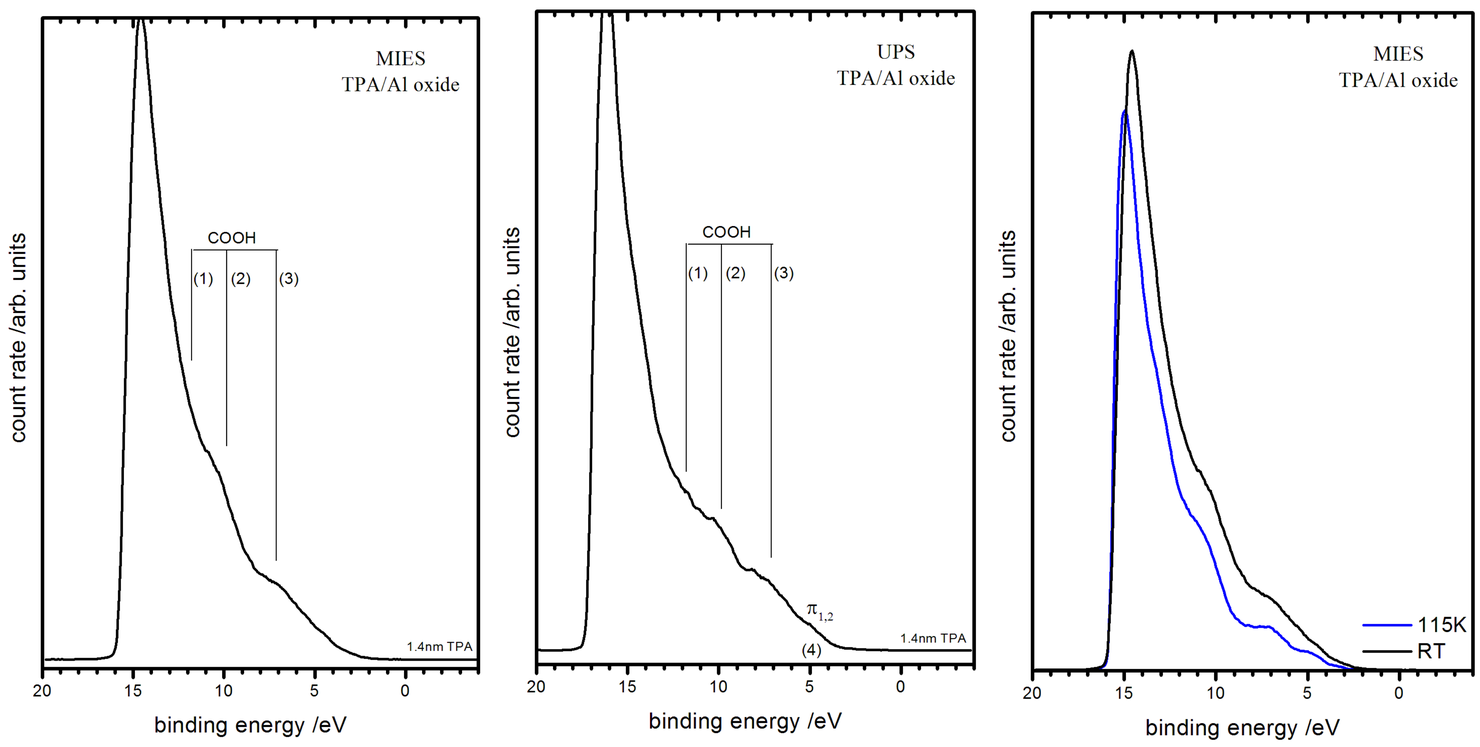
- peaks around 4 eV show the π orbitals
- In MIES: peaks around 6.5 eV, 10 eV and 12 eV show the components from the COOH group
- All orbitals of the TPA visible in MIES → more flat lying orientation, also in the multilayer region [1, 2]

Comparison of the X-oxy benzoic acid



- In MIES on Au: peaks around 4 eV of the π orbitals only visible for short chained molecules
- Additionally the structures at 6 eV and 10.5 eV can be attributed to the chain components
- In MIES on Al: only the chain components are visible

Spectra of thin films TPA on oxidized Al



- in MIES: at RT no π structures visible, only COOH components at 6.5 eV, 10 eV and 12 eV
- in UPS: additionally a slightly visible π structures at 5 eV
- An upright standing orientation of the terephthalic acid on the oxidized surface can be assumed [1]
- At 115K the π orbitals are clearly visible in the MIES spectra
  - ➢ Additional indication for an orientation effect on the oxidized Al surface at RT

Summary

- All experiments indicate a flat lying orientation of the molecules on the Au(111) surface.
- On the oxidized aluminum foil a more upright orientation can be assumed.
- At 115 K the π orbitals of the phenylic structure can be observed, which excludes a random arrangement of the TPA at RT.

References

[1] M. Marschewski, C. Otto, L. Wegewitz, O. Höfft, A. Schmidt and W. Maus-Friedrichs. APSUSC-D-14-05240

[2] S. Clair, S. Pons, A. P. Seitsonen, H. Brune, K. Kern and J. V. Barth, J. Phys. Chem. B 2004, 108, 14585-14590

8. Acknowledgement

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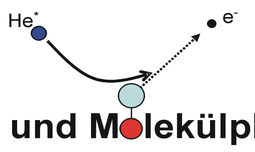

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