UNIVERSITÄT DUISBURG ESSEN

SFB 616 | A2

Chemically induced currents on metal surfaces

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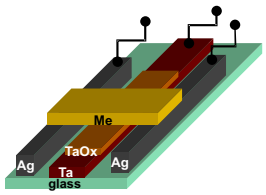
Our work

- Studying electronic excitation processes in the course of adsorption, chemisorption and surface reactions
- Understanding the role of single reaction steps in the entire process of chemically induced electronic excitation
- Characterisation of the hot charge carrier distribution

Methods

- Detection of electronic excitation as currents with 0 V tunnel bias in thin film metal-insulator-metal junctions
- Characterisation of reaction kinetics by guiding a bunch of atoms or molecules on the surface
- Energy selective detection of the electronic excitation by the application of a bias tunnel voltage

Experimental setup



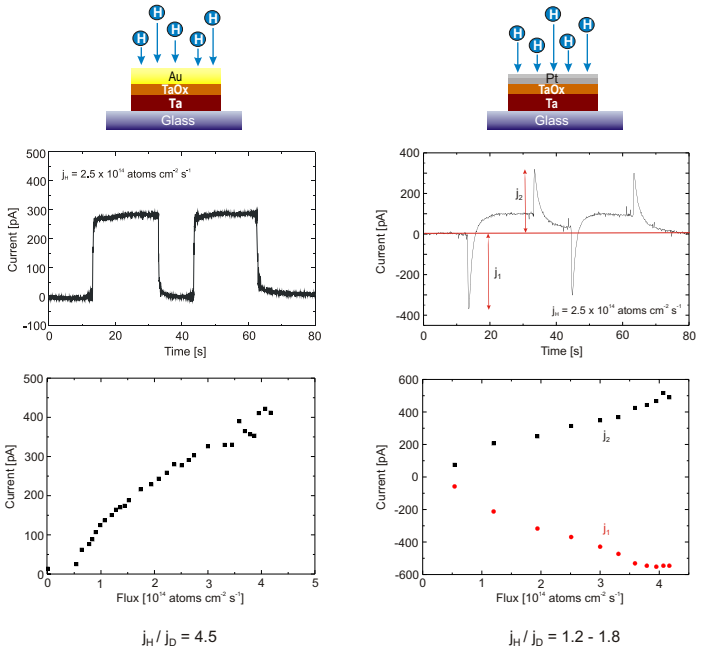
Layer system:

- 30 nm thick tantalum evaporated by e-beam
- 3-4 nm amorphous tantalum oxide produced by local electrochemical oxidation. Thickness adjustable to +/- 0.2 nm
- top electrode:

  15 nm thick gold film or 5 nm thick platinum film

  both, in situ prepared in UHV, polycristalline surface, preferentially 111 oriented

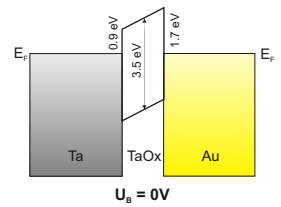
Experimental results



$j_H / j_D = 4.5$

$j_H / j_D = 1.2 - 1.8$

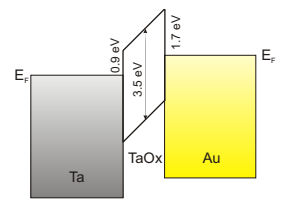
Energy selective detection of e-h pairs



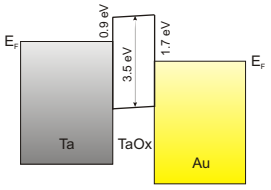
$U_B = 0V$

Properties of the MIM device:

- simultaneous detection of electrons and holes
- detection method which acts as a two band tunnel device
- applying a positive bias voltage facilitates tunneling for electrons
- applying a negative bias voltage facilitates tunneling for holes

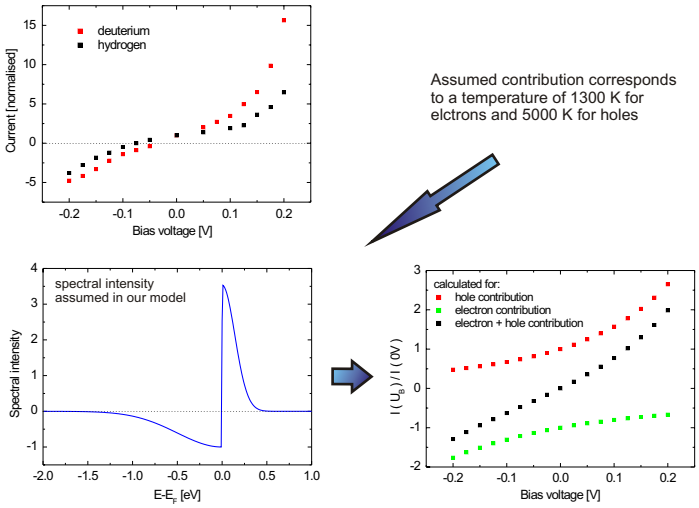


$U_B > 0V$



$U_B < 0V$

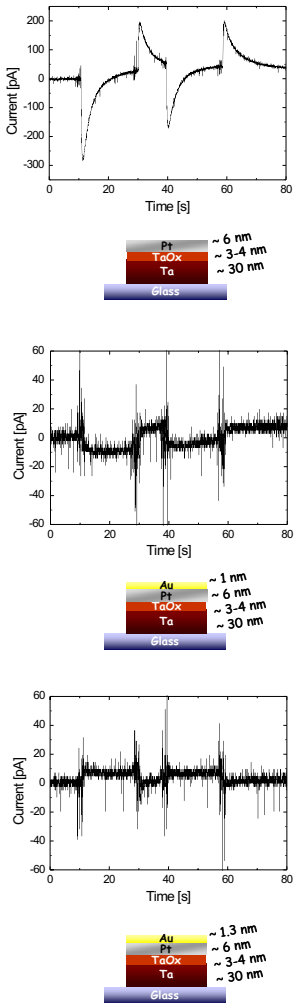
Energy selective detection of e-h pairs



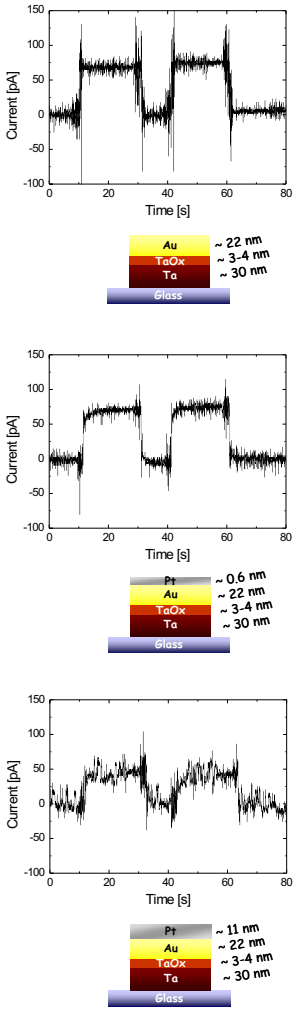
Assumed contribution corresponds to a temperature of 1300 K for elctrons and 5000 K for holes

H induced chemicurrent on bimetallic surfaces

Gold on platinum



Platinum on gold



- formation of a surface alloy, 3% of the Au atoms replaced by Pt
- Au substrate increases the Pt overlayer reactivity

[Besenbacher et al., Surface science, 426,(395-409),1999]

$2\Delta E(Pt\text{-}H) > \Delta E(H\text{-}H)$

No LH reaction on Platinum