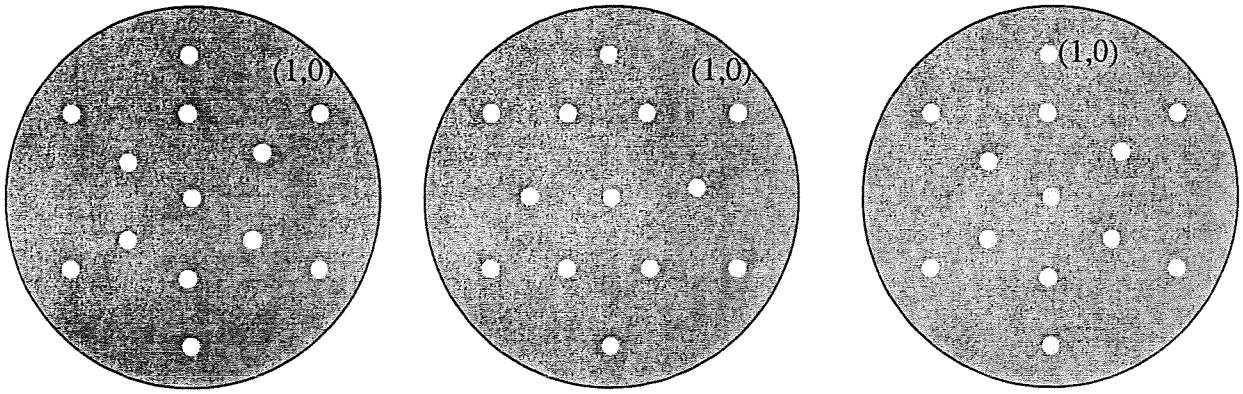
Tfy-3.468 Surface Physics

Examination Aug - 2008

1. Explain shortly what does the following abbreviations mean in surface science
   a) AFM
   b) EELS
   c) SEXAFS
   d) SIMS
   e) TDS
   f) UPS

1. The adjacent LEED images were recorded with different coverages of CO on Rh(111) surface. Name and draw the surface structures of the CO overlayer. The lattice parameter of Rh is 3.80 Å and Rh is an fcc metal.

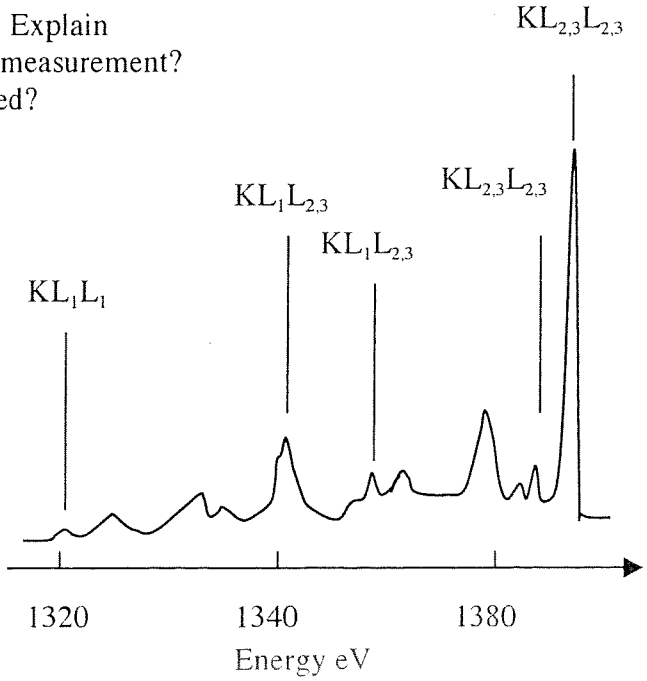


θ = 0.25 ML θ = 0.33 ML θ = 0.75 ML

3. Adsorption of 0.25 ML of sulfur on Ni(100) leads to a work function increase of 0.24 eV. Estimate the direction and degree of charge transfer between sulfur and nickel. The S-Ni distance has been determined to 1.3 Å. The lattice parameter of Ni is 3.51 Å and Ni is an fcc metal.

4. XPS is a well-known surface sensitive technique. Explain
   a) What equipment is needed to perform a XPS measurement?
   b) What is the physical origin of the data obtained?
   c) Why is this technique surface sensitive?

5. Below is measured the Auger spectrum of an Aluminum surface.
   a) Draw the schematic picture of one of the peaks showing the electrons involved in the process.
   b) At what energy you can see surface plasmons?
   c) What is the frequency of the surface plasmons?



TURN

Informaatio- ja luonnontieteiden tiedekunta
Teknillisen fysiikan laitos

(Pyydetään palauttamaan)

VAKIOIDEN ARVOJA

Planckin vakio	h	=	$6{,}6262 \cdot 10^{-34}$ J s = $4{,}136 \cdot 10^{-15}$ eV s
$h/2\pi$	$\hbar$	=	$1{,}055 \cdot 10^{-34}$ J s = $0{,}6582 \cdot 10^{-15}$ eV s
Valon nopeus tyhjiössä	c	=	$2{,}99792 \cdot 10^{8}$ m s^{-1}
	hc	=	$1{,}240 \cdot 10^{-6}$ eV m
Alkeisvaraus	e	=	$1{,}6022 \cdot 10^{-19}$ C (1 C = 1 A s)
Tyhjiön permeabiliteetti	μ_o	=	$4\pi \cdot 10^{-7}$ H m^{-1} (1 H = 1 V s A^{-1})
Tyhjiön permittiivisyys (permittiviteetti)	ε_o	=	$8{,}8542 \cdot 10^{-12}$ F m^{-1} (1 F = 1 A s V^{-1})
Avogadron vakio	N_A	=	$6{,}0220 \cdot 10^{23}$ mol^{-1}
Kaasuvakio	R	=	8,3144 J mol^{-1} K^{-1}
Boltzmannin vakio	k	=	$1{,}3807 \cdot 10^{-23}$ J K^{-1}
Stefanin ja Boltzmannin vakio	σ	=	$5{,}670 \cdot 10^{-8}$ W K^{-4}m^{-2}
Rydbergin vakio	R_∞	=	$10{,}97373177 \cdot 10^{6}$ m^{-1}
Atomimassayksikkö	u	=	$1{,}6605655 \cdot 10^{-27}$ kg = 931,50 MeV/c^2
Gravitaatiovakio	G	=	$6{,}672 \cdot 10^{-11}$ N m^2 kg^{-2}
Normaaliputouskiihtyvyys	g	=	9,80665 m s^{-2}
Elektronin massa	m_e	=	$9{,}10953 \cdot 10^{-31}$ kg = 0,00054858 u
	$m_e c^2$	=	0,5110 MeV
Protonin massa	m_p	=	$1{,}6726485 \cdot 10^{-27}$ kg = 1,0072765 u
	$m_p c^2$	=	938,28 MeV
Neutronin massa	m_n	=	$1{,}6749543 \cdot 10^{-27}$ kg = 1,0086650 u
	$m_n c^2$	=	939,57 MeV
Deuteronin massa	m_D	=	$3{,}3436370 \cdot 10^{-27}$ kg = 2,0135532 u
	$m_D c^2$	=	1875,63 MeV
α-hiukkasen massa	m_α	=	$6{,}6447631 \cdot 10^{-27}$ kg = 4,0015062 u
	$m_\alpha c^2$	=	3727,41 MeV
Bohrin vetyatomin säde	a_o	=	$5{,}29177 \cdot 10^{-11}$ m
Comptonin aallonpituus elektronille	λ_C	=	$2{,}4263 \cdot 10^{-12}$ m
Bohrin magnetoni	μ_B	=	$9{,}2741 \cdot 10^{-24}$ J T^{-1}
Ydinmagnetoni	μ_N	=	$5{,}0508 \cdot 10^{-27}$ J T^{-1}

Auringon säteilyn intensiteetti Maan etäisyydellä ilmakehän ulkopuolella (solaarivakio) 1,35 kW m^{-2} (1,3...1,4 kW m^{-2} vuodenajasta riippuen)

Veden ominaislämpö(kapasiteetti) 4,19 kJ kg^{-1}K^{-1}

Veden sulamislämpö (101,3 kPa) 334 kJ kg^{-1}

Veden höyrystymislämpö (100 °C, 101,3 kPa) 2256 kJ kg^{-1}