Study Ice on Neptunium

**PK: preparation chamber**

**AK: analysis chamber**

**ov: overview**

**RT: room temperature**

**17/06/2013**

Keep the old ThUO film in the system and sputter a new Np layer over it.

**Dep[s] Fil. Work Np (Targ.2) Ar O2**

60s 4.1V/3.2A 34V/21mA 700V/1.2mA 1.3e-6 --

001 ov

002 Np4f

**Dep[s] Fil. Work Np (Targ.2) Ar O2**

300s 5.8V/3.5A 42V/25mA 700V/1,5-2.0mA 1,4e -6 --

003 ov

004 Np4f

005 O1s

**Dep[s] Fil. Work Np (Targ.2) Ar O2**

300s 5.9V /3.5A 42V/ 2.6mA 700V/ 1.6mA 1.4e-6 5e-7

006 ov

007 Np4f

008 O1s ratio: 63%Np / 37%O

Sample in PK: 5E-5 exposed to oxygen for 50sec. (~2500 Langmuir) at RT

009 ov

010 Np4f

011 O1s ratio: 29%Np / 71%O

012 HeII

013 HeI

**18/06/2013**

014 ov

015 Np4f

016 O1s

**19/06/2013**

017 HeII old film from the day before yesterday. Finally liquid N2 available.

018 HeI

019 Np4f

+1.0\*10-5 mbar H2O (180sec), at -182°C up to -171°C (valve: scale 1.0 ) 15:20

UV source 71.3V/22.8A

020 HeII -171°C 15:23

021 HeI -168°C 15:26

022 HeII -165°C 15:28

023 HeI -160 15:32

024 HeII -155 15:36

025 HeI -152 15:38

026 HeII -150 15:40

027 HeI -116 15:44

028 HeII -99 15:46

029 HeI -74 15:48

030 HeII -63 15:50

031 HeI -47 15:53

032 HeII -38 15:55

033 HeI -23 15:57

034 HeII -14 16:00

035 HeI -10 16:03

036 HeII +1 16:07 source went out, restart!

Very bizarre!! The source is off but the count rate is higher than when the source is switched on

037 HeI +10 16:08

038 Np4f

039 Np4f Np4f5/2 detail

**20/06/2013**

040 ov fluorine on the film, I'll make a new one.

041 Np4f

**Dep[s] Fil. Work Np (Targ.2) Ar O2**

300s 6.5V/3.9A 42V/ 62mA 700V/ 1.8mA 5.7e-7 1e- 6

042 ov

043 Np4f

044 O1s

Sample in PK: 5E-6 exposed to oxygen for 100sec. (~500 Langmuir) at RT

045 Np4f

046 ov

047 O1s ratio: 34%Np / 66%O

048 HeII

049 HeI

Problems with Spikes in Analyzer. AK heated again for 48 hours!

**03/07/2013**

050 ov old film from 14 days ago, C contamination

**Dep[s] Fil. Work Np (Targ.2) Ar O2**

300s 6.2V /3.6A 42V/ 36mA 700V/ 1.9mA 1.1e-6 1e-6

051 ov

052 Np4f

053 O1s

Sample in PK: 5E-5 exposed to oxygen for 50sec. (~2500 Langmuir) at RT

054 ov

055 Np4f

056 O1s ratio: 29%Np / 71%O

057 HeII

058 HeI

+1.0\*10-5 mbar H2O (180sec), at -164°C (valve: scale 1.1) 11:45

UV source 77.8V/22.8A

059 HeII -161°C 11: 47

060 HeI -151 11:50

061 HeII -149 11:52

062 HeI -146 11:55

063 HeII -142 11:59

064 HeI -136 12:07

065 HeII -135 12:09

066 HeI -132 12:12

067 HeII -132 12:14

068 HeI -130 12:17

069 HeII -126 12:19

070 HeI -48 12: 25

071 HeII -30 12:28

072 HeI -20 12:31

073 HeII -16 12:33

074 HeI -11 12:36

075 HeII 0 12:38

076 HeI 11 12:40

077 HeII 25 12:43

078 HeI 25 12: 49

079 ov 20 15:53

080 Np4f

081 O1s

Both water/ice exposure sets show similar results. Reproducibly redox reactions are induced in the uppermost layers probed by UPS. XPS spectra show no major Np reduction in the bulk phase.

Note: (Part of the data is published in Cakir, R. Eloirdi, F. Huber, R.J.M. Konings, T. Gouder, Surface reduction of neptunium dioxide and uranium mixed oxides with plutonium and thorium by photocatalytic reaction with ice, Journal of Physical Chemistry C, 119 (2015) 1330-1337)