MS 7: Poster

Zeit: Mittwoch 16:30–18:30 Raum: Poster A

MS 7.1 Mi 16:30 Poster A

MATS - Measurements with an Advanced Trapping System at the future GSI facility FAIR — •Klaus Blaum[1,2], Frank Herfurth[1], and Collaboration MATS[1] — [1]GSI Darmstadt, 64291 Darmstadt, Germany — [2]Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany

The mass and its inherent connection with the nuclear binding energy is one of the fundamental properties of a nuclide. Thus, precise mass values are important for a variety of applications, ranging from nuclear-structure studies like the investigation of shell closures, test of nuclear mass models and mass formulas, to tests of the weak interaction and of the Standard Model. The required relative precision ranges from 10^{-5} to below 10^{-8} for radionuclides, which most often have half-lives well below 1 s. Substantial progress in Penning trap mass spectrometry has made this method a prime choice for precision measurements on rare isotopes. The technique has the potential to provide high accuracy and sensitivity even for very short-lived nuclides. Furthermore, ion traps can be used and offer advantages for precision decay studies. With MATS at FAIR we aim for applying both techniques to very short-lived radionuclides: High-precision mass measurements and in-trap conversion electron and alpha spectroscopy. The experimental setup of MATS is a unique combination of an electron beam ion trap for charge breeding, ion traps for beam preparation, and a high precision Penning trap system for mass measurements and decay studies. The proposed setup and the planned experimental program will be presented.

MS 7.2 Mi 16:30 Poster A

Enantiosensitive Laser-Massenspektrometrie auf unterschiedlichen Multi-Photonen-Anregungswegen — •Christoph Logé, Alexander Bornschlegl und Ulrich Boesl — Technische Universität München - Department Chemie - Physikalische Chemie 1 - Lichtenbergstr. 4 - 85748 Garching

Optisch aktive Substanzen sind in sämtlichen Bereichen der Chemie von größter Bedeutung. Eine Unterscheidung der zwei Enantiomere einer solchen Substanz gelingt mit zirkular polarisiertem Licht. In Kombination mit Massenspektrometrie ist enantiosensitive Lasermassenspektrometrie (CD-LAMS) möglich [1]. Der maximale Wert des relativen Circulardichroismus für (R)-(+)-3-Methylcyclopentanon wurde zu 26 % festgestellt. Ursache des Effektes ist eine Aufsummierung der Einzelwerte aufeinander folgender Übergänge in einer 1+1+1-Multiphotonenionisation mit Laserlicht der Wellenlänge 324 nm. Der Einsatz verschiedener Wellenlängen (324 nm/213 nm) ermöglicht durch eine 1+1 Multiphotonenionisation einen Gewinn an Molekülionen. Vor allem bei stark fragmentierenden Verbindungen ist dies für von wesentlicher Bedeutung. Neben Einphotonenprozessen wurden auch Zweiphotonenprozesse untersucht. Diese lassen einen deutlich unterschiedlichen Circulardichroismus erwarten [2].

[1] A. Bornschlegl and U. Boesl, ChemPhysChem, 7, (10), 2006, 2085-2087.

[2] R. Li, R. Sullivan, W. Al-Basheer, R. M. Pagni and R. N. Compton, J. Chem. Phys., 125, (14), 2006.

MS 7.3 Mi 16:30 Poster A

Resonante Lasermassenspektrometrie in der Spurenanalytik - Tracermoleküle im Abgas von Verbrennungsmotoren — •Stefan Sellmeier, Rares Vintan und Ulrich Boesl — Physikalische Chemie 1, Deparment Chemie der Technischen Universität München, Lichtenbergstr. 4, D-85748 Garching

Die Lasermassenspektrometrie stellt eine hervorragende analytische Methode zum Spurennachweis einzelner Stoffe in komplexen Mischungen dar. So wird sei z.B. beim Nachweis von Tracermolekülen im Abgas von Verbrennungsmotoren zur kontinuierlichen Ölverbrauchsmessung eingesetzt.[1] Als Tracermolekül wird Pyren verwendet.

Es zeigte sich allerdings, dass der häufig verwendete Tracer Pyren nicht bei allen Betriebszuständen des Motors verlustfrei mit dem Abgas emittiert wird. Bei hohen Abgastemperaturen reagiert ein Teil des Tracers an den heißen Oberflächen im Krümmer bzw. Auspuff mit Restsauerstoff im Abgas und verbrennt auf diese Weise. Dies erschwert eine quantitative Messung des Ölverbrauchs beträchtlich. Durch zahlreiche Untersuchungen unter Laborbedingungen war es möglich, die Abhängigkeit des Pyrenverlustes von Temperatur und Sauerstoffgehalt des Gases gezielt nachzuvollziehen. Der zu erwartende Pyrenverlust konnte sogar durch die Ermittlung der Verbrennungskinetik vorhergesagt werden.

[1]: Püffel, P. K.; Thiel, W.; Frey, R.; Boesl, U.; SAE SP, 1998, 1389, p 27-33.

MS 7.4 Mi 16:30 Poster A

Electrospray Ionization Mass Spectrometry and Vacuum Deposition — •Stephan Rauschenbach, Nicha Thontasen, Nicola Malinowski, and Klaus Kern — Max-Planck-Institut for Solid State Research, Nanoscale Science Department, Heisenbergstr. 1, 70569 Stuttgart

Scanning Tunneling microscopy offers an atomic scale view of functional molecules and nanostructures at surfaces. In case of large biological molecules or inorganic nanoparticles, their controlled deposition on well defined surfaces under ultra-high vacuum conditions is hindered by their low vapor pressure.

Electrospray Ionization (ESI) is widely used as ionization technique for mass spectrometric applications in biology and organic chemistry, because of the unique destruction free ionization of even large biological molecules from solution. Here it is used to create an ion beam for soft landing vacuum deposition. The ion beam is guided by RF- and electrostatic ion optics through several pumping stages into ultrahigh vacuum.

Using time-of-flight mass spectrometry the composition of the beam can be characterized before deposition. The deposition of clusters, large molecules and proteins was demonstrated for high vacuum conditions. Current studies are focusing on the destruction free deposition of molecules and clusters, so called soft landing.

S. Rauschenbach, F. Stadler, E. Lunedei, N. Malinowski, S. Koltsov, G. Costantini, K. Kern, *Electrospray Ion Beam Depostion of Clusters and Biomolecules*, Small **4** (2006)

MS 7.5 Mi 16:30 Poster A

Investigation of the octupolar excitation with the FT-ICR detection scheme — •Martin Breitenfeldt[1], Sudarshan Baruah[1], Alexander Herlert[2], Franklin Martinez[1], Gerrit Marx[1], Lutz Schweikhard[1], Noelle Walsh[1], and Falk Ziegler[1] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität, Domstr. 10a, D-17487 Greifswald — [2]Physics Department, CERN, CH-1211 Geneva 23

In the rapidly progressing field of mass spectrometry with Penning traps the manipulation of the eigenmotion of the ions by an octupolar rf field is a new approach to improve the relative uncertainty of measured frequencies $\Delta\nu_c/\nu_c$. While an increase by a factor of two in the achievable resolving power is expected due to doubling the excitation frequency, it has been observed that the increase can be as high as a factor of ten [Eliseev et al., Ringle et al., both IJMS, in print]. In this contribution a method is presented to further study the excitation modes in general, and in particular to simultaneously monitor the change of the magnetron and cyclotron motion. The different behavior of these two eigenmotions under damping and decoherence due to collisions with background gas has been investigated. In addition, the shift of the eigenfrequencies caused by image charges in the ring electrodes has been studied.

MS 7.6 Mi 16:30 Poster A

A setup for providing cooled, selected and bunched metal-cluster ions for photon-interaction studies — •Martin Arndt, Hagen Ritter, Gerrit Marx, and Lutz Schweikhard — Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Domstraße 10a, 17489 Greifswald

The ion beam coming from a magnetron sputter cluster source is guided through a system of ion optics and a quadrupole bender for focusing and charge selection. The cluster ions of a particular charge state are accumulated, mass-selected and cooled in a linear Paul trap. The mass selection is realized either by using the Paul trap as mass-filter and trap simultaneously or by transversal extraction of defined mass-over-charge values achieved by application of an additional quadrupolar field. Both methods are applied and results are presented. The cluster ions are cooled by buffer gas collisions. The cooled ion bunch is then transferred into a three-dimensional Paul trap for investigation of cluster laser interaction as part of the collaborative research center

SFB 652.

MS 7.7 Mi 16:30 Poster A

The effect of gold doping on the reactivity of free silver clusters: Comparison of Ag3+ and Ag2Au+ — •Denisia Popolan, Mihai Vaida, and Thorsten Bernhardt — Universität Ulm, Institut für Oberflächenchemie und Katalyse, Ulm, Germany

The chemistry of noble metal clusters was intensively studied in recent years. This is due to their fascinating properties acting as promising low temperature catalytic materials. However, the surprising reactive behavior is still far from being completely understood. Free gas phase clusters investigated by mass spectrometric methods might help to shed light on the reaction mechanisms and size effects in reactivity. Besides the pure free gold and silver clusters also mixed silver-gold clusters have been investigated. Insight into the active role of gold as a catalyst and into the possibilities of doping effects using gold atoms will help in the comprehension of the reactive properties of bimetallic clusters. Our investigations aim to elucidate the influence on the reactivity when silver atoms in Agn clusters are replaced atom by atom. In this contribution results on the reactivity of Ag3+ with carbon monoxide at temperatures between 100 and 300 K are presented. The effect of introducing one gold atom on the chemical reaction kinetics is studied by comparison with the cluster Ag2Au+. The investigations are performed in a low energy ion beam apparatus consisting of a sputter cluster ion source and of a temperature variable octopole ion trap inserted into a multiple quadrupole mass spectrometer arrangement.

MS 7.8 Mi 16:30 Poster A

Recent high-precision mass measurements on radionuclides with the Penning trap mass spectrometer ISOLTRAP — •Alexander Herlert — CERN, Physics Department, 1211 Geneva 23, Switzerland – for the ISOLTRAP Collaboration

With the Penning trap mass spectrometer ISOLTRAP the masses of short-lived Al, Ca, Mn, Fe, Cd, and Ag isotopes have been measured in 2006. The masses of ^{26}Al and ^{38}Ca contribute as input values for a test of the unitarity of the CKM quark mixing matrix. Since the absolute mass uncertainty needs to be well below 1 keV, a new Ramsey excitation scheme with time-separated rf excitation fields has been applied, leading to a higher precision for the determination of the cyclotron frequency. For the neutron-rich Ag isotopes, isomers were present in the ISOLDE beam. By application of a dipolar excitation either the ground state or the isomeric state was selected for the investigation [1]. Especially for ^{118}Ag only the isomeric state has been investigated. In case of the Mn isotopes the in-trap decay method [2] has been applied in order to produce neutron-rich Fe isotopes which are in general not available at the ISOLDE facility. To this end, Mn ions with mass $A = 61 - 63$ have been stored for one second in the preparation Penning trap and the corresponding Fe ions were created by beta decay and stored after buffer gas cooling and centering before being transferred to the precision trap for mass measurement. An overview of the results and an update of technical developments are presented.

[1] K. Blaum et al., Europhys. Lett. 67, 586 (2004)
[2] A. Herlert et al., New J. Phys. 7, 44 (2005)