WEMS 2019

Report of Contributions

https://indico.cern.ch/e/WEMS2019

Contribution ID: **1** Type: **not specified**

Welcome

Monday 15 July 2019 09:00 (5 minutes)

Presenters: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS)); UNZUETA SOLOZABAL, Iraultza (Universidad del País Vasco / Euskal Herriko Unibertsitatea (ES))

Session Classification: Introduction

Contribution ID: **2** Type: **not specified**

Results obtained in LiF

Tuesday 16 July 2019 13:50 (15 minutes)

I will give an overview of the results obtained in LiF from 2018. Fe is observed at Fe1+ S=1/2 as in NaCl and additionally as Fe2+, presumably in low spin configuration

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **3** Type: **not specified**

57Fe Mössbauer study on the lattice defects in the TiN thin film & 57Fe Mössbauer study on the lattice defects in VN thin film for catalyst applications

Monday 15 July 2019 14:50 (10 minutes)

TiN thin films are interesting gate materials in future non-Si based metal-oxide semiconductor devices. TiN has also been experimentally confirmed with strong surface plasmon resonance at the near infrared spectral range. In water splitting experiments, TiN nanoparticles were found to outperform Au nanoparticles in the enhancing photocurrent under solar irradiation. However, the performance of a TiN thin film is closely related to the concentration and mobility of lattice defects in the thin film structure. This makes a local atomic scale study of TiN thin films an ever-growing demand. Here we present the results obtained with the Emission 57Fe Mössbauer spectroscopy on an epitaxial TiN thin film from our recent paper (https://doi.org/10.1016/j.apsusc.2018.09.107). With the help of theoretical calculations, our results show that most implanted Fe ions are with 2+ valence state and locate at the Ti sublattice in the bulk-like single crystalline grains. The interstitials Fe reside only at the grain boundaries. A small percentage of nitrogen point defects (vacancy VN and interstitial NI) are observed in the bulk-like crystalline grains. The temperature dependent delicate mobility of intestinal N and lattice N has been also noticed. The titanium vacancy (VTi) is only detected at the grain boundaries and can be recovered with annealing up to 813 K. annealing. However, no evidence of ferromagnetism due to dilute implantation of 57Mn/57Fe and or structural defects in the film is obtained. This study demonstrates that the Emission Mössbauer spectroscopy is a powerful tool to study the local configuration and mobility of the lattice defects in TiN thin film, as well as the possibility of defect-induced or dilute-ferromagnetism of the thin film on an atomic scale.

On top of the conventional application of vanadium nitride (VN) as abrasive materials and cutting tools for its high hardness. VN is currently found renowned interest in its use as a pseudocapacitive electrode in an electrochemical capacitor, owing to its excellent electrochemical property, such as good electronic conductivity, thermal stability, high density and high specific capacitance.VN is also found interest as a practical catalyst because of its high catalytic activity and selectivity comparable to those of noble metals. Moreover, VN is superconductor with a transition temperature of 6–9 K. Among these applications, thin film and nanostructured VN are more favorable than the bulk form owing to the large specific surface area and the rich defect-mediated electrochemical & catalytic behaviors. Therefore, local control and characterization of the lattice defects and their mobility in the thin film and nanostructured VN are very important. Here we intend to give a brief introduction on the first result obtained on an ultra-thin epitaxial VN thin film by the Emission Mössbauer spectroscopy.

Presenter: QI, Bingcui (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **4** Type: **not specified**

Local metal-insulator transitions in V2O3 thin films studied by 57Fe emission Mössbauer spectroscopy

Tuesday 16 July 2019 15:35 (10 minutes)

Metal to Insulator-to-transitions (MIT) driven by electronic interactions in strongly correlated materials are among the most remarkable phenomena in condensed matter physics. It has been found important applications in the next-generation so-called "beyond silicon"electronics and neuromorphic devices. Vanadium sesquioxide V2O3 is a prototypical Mott insulator, which undergoes the MIT between an antiferromagnetic insulator (AFI) and a paramagnetic metal (PM) or a paramagnetic insulator (PI) by varying the temperature, pressure, doping of material or photoexcitation. However, the origin of MIT in V2O3 is still an on-going topic of active study owing to a complex interplay of multiple factors, such as the crystal-field splitting, electron-lattice interaction and orbital degeneracy, in the Mott transition. Particularly, in the thin film V2O3, the magnitude and temperature of the transition can be greatly affected by the local structural defects, material stoichiometry and film stress. Here we present the 57Fe emission Mössbauer spectroscopy study of the local MIT transition in the V2O3 thin films, which were grown with different crystalline and structural properties. The results show that…

Presenter: QI, Bingcui (University of Iceland (IS))

Session Classification: Oxides - Results

Contribution ID: **5** Type: **not specified**

Local metal-insulator transitions in VO2 thin films studied by 57Fe emission Mössbauer spectroscopy

Tuesday 16 July 2019 15:55 (10 minutes)

VO2 shares the similar metal-insulator transitions (MIT) and structural phase transition properties as the V2O3 and found equally important applications in Mott memory and neuromorphic devices, which surpass the limitations of conventional electronics. In contrast, MIT occurs at much higher temperature (340 K) in VO2 that that (160 K) in V2O3. Furthermore, the MIT of VO2 is much more robust and less susceptible to implantation-induced disorder than for V2O3. This indicates that the formation of the MIT and the structural-phase transition in VO2 are dominated by local properties, which is more suitable to be probed by the emission Mössbauer spectroscopy. Based on the results obtained from V2O3 in 2016 and 2017 beam times, we noticed that the V2O3 was prone to implantation damage, this limits the power of the emission Mössbauer spectroscopy to closely follow the MIT process. Although some measurements were done on the VO2 thin film samples in 2015, the results are not conclusive mostly due to the film quality. Here we propose to refocus on the application of emission Mössbauer spectroscopy to study the local-scale MIT phenomena in VO2 thin films with improved structural and stoichiometric quality.

Presenter: QI, Bingcui (University of Iceland (IS))

Session Classification: Oxides - Results

Contribution ID: **6** Type: **not specified**

Isomer shifts in binary covalent systems (invited)

Monday 15 July 2019 14:20 (30 minutes)

I will talk about the semi-emperical model ...

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **7** Type: **not specified**

Overview paper on silicon - status

Tuesday 16 July 2019 09:30 (5 minutes)

Presenter: NAIDOO, Deena (University of the Witwatersrand)

Session Classification: Silicon - Results

Contribution ID: **8** Type: **not specified**

Paper on vacancy diffusion in SiGe

Tuesday 16 July 2019 09:40 (10 minutes)

Presenter: NAIDOO, Deena (University of the Witwatersrand)

Session Classification: Silicon - Results

Contribution ID: **9** Type: **not specified**

In in group IV semiconductors

Tuesday 16 July 2019 09:35 (5 minutes)

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Silicon - Results

Contribution ID: **10** Type: **not specified**

Modelling of cage motion in silicon

Tuesday 16 July 2019 09:50 (15 minutes)

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Silicon - Results

Contribution ID: **11** Type: **not specified**

Future of Iron in silicon - discussion

Tuesday 16 July 2019 10:05 (10 minutes)

Presenter: NAIDOO, Deena (University of the Witwatersrand)

Session Classification: Silicon - Results

Contribution ID: **12** Type: **not specified**

AlGaN and InGaN: Overview of Proposals

Monday 15 July 2019 10:45 (15 minutes)

An overview of results from the binary system will be given and the differences observed in their corresponding spectra that paved a way for studying the ternary system will be highlighted.

Presenter: Dr MASENDA, Hilary (University of the Witwatersrand)

Session Classification: Nitrides - Results

Contribution ID: **13** Type: **not specified**

InGaN - Preliminary analysis + Remaining Shifts

Monday 15 July 2019 12:00 (20 minutes)

Presenter: MASENDA, Hilary (University of the Witwatersrand)

Session Classification: Nitrides - Results

Contribution ID: **14** Type: **not specified**

Charge states of Fe in AlGaN and AlGaN:Mn

Monday 15 July 2019 11:15 (15 minutes)

The spectra for Fe implanted AlGaN show the presence of magnetically-split sextets in the “wings” , similar to features observed in GaN and AlN, attributed to Fe3+ on Al/Ga sites showing slow paramagnetic relaxations. The central part of the spectra is characterised by paramagnetic Fe2+ on Al/Ga sites associated with nitrogen vacancies. However, with Mn doping, the contribution of Fe3+ is considerably reduced or negligible. This is coupled with the corresponding emergence of a single line component with Mössbauer parameters typical of Fe4+ on Al/Ga sites, which are acceptors in AlGaN.

Presenter: MASENDA, Hilary (University of the Witwatersrand)

Session Classification: Nitrides - Results

Contribution ID: **15** Type: **not specified**

Charge state engineering and tuning of transparent conducting properties in MoOx

Monday 15 July 2019 16:55 (20 minutes)

Presenter: ADHIKARI, Rajdeep

Session Classification: Oxides - Results

Contribution ID: **16** Type: **not specified**

Nitrides as radiation detectors

Monday 15 July 2019 11:00 (15 minutes)

Presenter: ADHIKARI, Rajdeep

Session Classification: Nitrides - Results

Contribution ID: **17** Type: **not specified**

III-Nitride alloys: a recent update - growth and structural characterization

Monday 15 July 2019 11:30 (30 minutes)

Presenter: ADHIKARI, Rajdeep

Session Classification: Nitrides - Results

Contribution ID: **18** Type: **not specified**

Beam time 2018: Overview

Monday 15 July 2019 10:20 (10 minutes)

An overview of the beam-time will be given focusing on the status of measurements, equipment and challenges.

Presenter: MASENDA, Hilary (University of the Witwatersrand)

Session Classification: Introduction

Contribution ID: **19** Type: **not specified**

Resaults obtained in NaCl

Monday 15 July 2019 15:20 (15 minutes)

I will talk about the results obtained in NaCl in Mn18. A single line is observed that can be interpreted as due to singly charged Fe in S=1/2 spin state

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **20** Type: **not specified**

Results obtained in MF2 (M = Mg, Ca, Ba)

Tuesday 16 July 2019 14:20 (15 minutes)

I will describe the results obtained in di-fluorides from Mn18

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **21** Type: **not specified**

Fe at the interface with 2D-transition metal dichalcogenides and topological insulators (invited)

Monday 15 July 2019 15:55 (30 minutes)

The integration of ferromagnetic thin films (FM) with the classes of two dimensional (2D) transition metal dichalcogenides (TMD) and topological insulators (TI) constitutes a very promising route to build-up the next generation of spintronic devices [1]. In particular, the use of TMD and TI can boost the efficiency of the spin orbit torque exerted to an adjacent FM layer, by taking advantage from the large intrinsic spin orbit coupling in TMD, and from topologically protected spin-polarized edge states in TI. In this contribution we present the structure, chemical composition and magnetism of the interface between Fe thin films and two prototype 2D-TMD and TI systems, namely 2D-MoS2 and Sb2Te3 as mainly obtained by means of conversion electron Mössbauer spectroscopy (CEMS) [2,3]. Our results constitute a first step toward the full understanding of the interface properties of these systems, with the perspective to engineer ultra-low-power spintronic devices in the near future.

[1] F. Hellman et al., Rev. Mod. Phys. 89, 025006 (2017)

[2] R. Mantovan et al., Phys. Status Solidi A 215, 1800015 (2018)

[3] E. Longo et al., J. Magn. Magn. Mat. 474, 632 (2019)

Presenter: Dr MANTOVAN, Roberto (CNR-IMM Agrate Unit (IT))

Session Classification: Oxides - Results

Contribution ID: **22** Type: **not specified**

Welcome and Physics in Bilbao

Monday 15 July 2019 09:05 (30 minutes)

The talk is intended to welcome all the participants to Bilbao and to the University of the Basque Country (UPV/EHU). Further, the main investigation lines of the group lead by F. Plazaola will be presented, along with the latest results obtained in Hyperthermia, Shape Memory Alloys, Mössbauer spectroscopy and Positron Annihilation Lifetime Spectroscopy.

Presenter: Prof. PLAZAOLA MUGURUZA, Fernando (University of the Basque Country (UPV/EHU))

Session Classification: Introduction

Contribution ID: **23** Type: **not specified**

Status and Results of MnxGa Alloys

Tuesday 16 July 2019 11:40 (15 minutes)

An overview of the eMS measurements (119In / Sn and 57Mn / Fe) carried out in MnxGa (x = 0.7, 0.8, 1.1, 1.4, 1.9) alloys (2014-2018) is presented. The most relevant results obtained from the data fitting will be highlighted. In the final part of the talk, a time for a quick discussion on the interpretation of the results will be given.

Presenter: UNZUETA SOLOZABAL, Iraultza (Universidad del País Vasco / Euskal Herriko Unibertsitatea (ES))

Session Classification: Mn Alloys

Contribution ID: **24** Type: **not specified**

eMS Results in Heusler and Pd2MnSb Alloys

One of the main conclusions obtained by ion-implanting and subsequent eMS measurements in Ni-based Heusler alloys performed at ISOLDE, is that the implantation damage destroys the local magnetism. eMS measurements are compared with transmission 119Sn Mössbauer measurements, where a clear influence of the implantation damage is observed.

Presenter: UNZUETA SOLOZABAL, Iraultza (Universidad del País Vasco / Euskal Herriko Unibertsitatea (ES))

Session Classification: Mn Alloys

Contribution ID: **25** Type: **not specified**

SPES: An intense source of radioactive beams at Legnaro

Wednesday 17 July 2019 09:00 (30 minutes)

The SPES project at the Laboratori di Legnaro of INFN (Italy), currently in the construction phase, consists of a new cyclotron accelerator delivering high intensity, up to 70 MeV proton beams. The beam impinges on an ISOL target for the production of a variety of radioactive nuclei for nuclear physics experiment.

Its target-ion source complex represents the core of an ISOL facility. In particular, the choice of the target material is vital to ensure excellent performances in terms of quantity and regularity of the isotopic yields over the duration of beam delivery.

The main target material for nuclear physics applications will be fissile. Such configuration will provide intense neutron-rich radioactive ion beams obtained by proton-induced fission of a uranium carbide (UCx). Besides this, silicon carbide (SiC) will be used to deliver p-rich beams.

The exotic isotopes generated in the target are ionized, mass separated and initially delivered to a beam line dedicated to experimental measurements at low energy.

The status of the project and the radioactive ion beams that will be delivered after the facility commissioning will be presented.

The aim is to trigger a discussion on the potential exploitation of the SPES facility and of decay and hyperfine interaction techniques to gain microscopic information on the structural and dynamic properties of new materials, thin films and interfaces in nuclear technology and nanoscience.

Presenter: ANDRIGHETTO, Alberto (INFN Laboratori di Legnaro)

Session Classification: Future shifts/proposals

Contribution ID: **26** Type: **not specified**

Annealing studies with emission Mössbauer spectroscopy using short lived parent isotopes: Properties of implantation damage in ZnO

Tuesday 16 July 2019 14:45 (15 minutes)

I will briefly describe the status on “quenching”. A manusrcript is ready but needs feedback

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **27** Type: **not specified**

Proposal on Halides and Fluorides

Wednesday 17 July 2019 10:45 (15 minutes)

I will talk about possibiliites of making a proposal on Halides and Fluorides

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Future shifts/proposals

Contribution ID: **28** Type: **not specified**

High energy shifts

Wednesday 17 July 2019 10:25 (5 minutes)

We have few high energy shifts (I161), what to do with them?

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Future shifts/proposals

Contribution ID: **29** Type: **not specified**

Overview of Mn-based Alloys: Measurement Status

Tuesday 16 July 2019 10:55 (15 minutes)

Mn-based Alloys are characterized by a wealth of properties, which are of interest both from fundamental physics point of view and particularly attractive for different applications in modern technology. In order to uncover new routes towards the optimization of the properties of these materials, it is crucial to establish a direct correlation between macro- and micro-scaled structural/magnetic properties.

The Mössbauer effect is applied at 57Fe and 119Sn sites following implantation of radioactive 57Mn and 119In ions, to probe the micro-structure and magnetism at atomic-scale level. Within this proposal, three different Mn-containing alloys have been studied: 1) MnSi, 2) MnGa and 3) Ni-Mn-Z (Z=Ga,Sn,In). The talk is directed to give a general overview of the proposal, as well as about its status and the remaining shifts.

Presenters: UNZUETA SOLOZABAL, Iraultza (Universidad del País Vasco / Euskal Herriko Unibertsitatea (ES)); MANTOVAN, Roberto (CNR-IMM Agrate Unit (IT))

Session Classification: Mn Alloys

Contribution ID: **30** Type: **not specified**

MnSi Alloys: SQUID results

Tuesday 16 July 2019 11:10 (15 minutes)

The talk will be focused on the results of Si-implanted MnSi alloys and particularly on SQUID results.

Presenter: ZENKEVICH, Andrei (MIPT)

Session Classification: Mn Alloys

Contribution ID: **31** Type: **not specified**

epsilon-FeSi thin film and single crystal: a comparison between eMS and CEMS

Tuesday 16 July 2019 11:25 (15 minutes)

A comparison between eMS and CEMS will be presented in e-FeSi thin film and single crystals.

Presenter: MANTOVAN, Roberto (CNR-IMM Agrate Unit (IT))

Session Classification: Mn Alloys

Contribution ID: **32** Type: **not specified**

Remaining Shifts in Mn-Based Alloys

Tuesday 16 July 2019 11:55 (15 minutes)

There are remaining shifts, particularly 119In shifts, which will help on the interpretation of the local magnetism in MnxGa alloys.

Presenters: UNZUETA SOLOZABAL, Iraultza (Universidad del País Vasco / Euskal Herriko Unibertsitatea (ES)); MANTOVAN, Roberto (CNR-IMM Agrate Unit (IT))

Session Classification: Mn Alloys

Contribution ID: **33** Type: **not specified**

Overview and Preliminary results from InGaAs

Tuesday 16 July 2019 14:35 (10 minutes)

Presenter: BHARUTH-RAM, Krish

Session Classification: Opportunistic science - Results

Contribution ID: **35** Type: **not specified**

Ar and C doped ZnO

Tuesday 16 July 2019 16:55 (20 minutes)

Presenter: BHARUTH-RAM, Krish

Session Classification: Oxides - Results

Contribution ID: **36** Type: **not specified**

eMS and CEMS on (virtually) room-T ferromagnetic FeGe single crystal

Tuesday 16 July 2019 12:10 (5 minutes)

The eMS and CEMS on (virtually) room-T ferromagnetic FeGe single crystal will be exposed and discussed in this talk.

Presenter: MANTOVAN, Roberto (CNR-IMM Agrate Unit (IT))

Session Classification: Mn Alloys

Contribution ID: **37** Type: **not specified**

eMS at ISOLDE

Monday 15 July 2019 10:05 (15 minutes)

I will give a quick overveiw of the facilities available

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Introduction

Contribution ID: **38** Type: **not specified**

Oveview of the IS501 experiment

Monday 15 July 2019 16:25 (10 minutes)

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Oxides - Results

Contribution ID: **39** Type: **not specified**

Resaults obtained in fluoride doped SnO2

Tuesday 16 July 2019 15:45 (10 minutes)

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Oxides - Results

Contribution ID: **40** Type: **not specified**

Measurements of 57Mn implanted LiNbO3 and LaTaO3

Tuesday 16 July 2019 16:05 (10 minutes)

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Oxides - Results

Contribution ID: **41** Type: **not specified**

Subatomic nuclear activity in the Hydrogen based Rydberg matter state

Tuesday 16 July 2019 09:00 (30 minutes)

Presenter: OLAFSSON, Sveinn (University of Iceland (IS))

Session Classification: Silicon - Results

Contribution ID: **42** Type: **not specified**

Charge imbalance by charged particle irradiations: Experiences from Optically Stimulated Luminescence and Implications for Mössbauer spectroscopy

Monday 15 July 2019 13:50 (30 minutes)

Irradiating with charged particles can result in the build-up of a net charge in the irradiated material if the range of the particles is shorter than the shortest dimension of the material. This results in a net stored charge in the material, and may ultimately lead to charge break-down. The phenomenon is often observed in insulators or wide-band gap semi-conductor materials (e.g. Blaise and Le Gressus, 2018). Charge imbalance has been investigated using Optically Stimulated Luminescence (OSL); this technique gives indirect information on trapped electrons and holes in a material (Autzen et al., 2018). These experiments show that the luminescence response decreases at large doses when irradiating with 200 keV electrons, possibly as a result of changes in hole populations as excess electrons combine with trapped holes. This hypothesis is supported by GEANT4 modelling which shows that there is a significant net deposition of excess electrons during such irradiations.

Our interest is to study the phenomenon of possible charge build up in the wide-bandgap materials such as feldspar and quartz (SiO2). The internal charge is difficult to measure, but may have implications for the emission Mössbauer spectroscopy performed at ISOLDE/CERN.

It is hypothesised that the observed fluence-dependent ratio of Fe2+/Fe3+ in ZnO (Mølholt et al., 2009) is caused by charge imbalance. This ratio stabilises after a certain fluence (dose), possibly because of a lack of available electrons to compensate for the extra induced positive charge (charge imbalance), and not as a result of damage-induced vacancies as proposed earlier. If it is caused by unbalanced charge, subsequent electron beam irradiations would be expected to change the ratio. On the other hand reducing the mobility of vacancies with low temperature would point towards the damage-induced mechanism.

Our interest is to discuss possible emission Mössbauer experiments in order to stimulate charge imbalance and investigate resulting effects. One way to promote charge imbalance is by post e-beam irradiation, but a better solution could be with an on-line electron gun irradiation during implantation at ISOLDE. PMMA (plastic) may be a good test-system, since its properties are known to allow charge build-up and subsequent break-down, but minerals such as K-feldspar and ZnO are also potential targets.

G. Blaise, and C. Le Gressus, Electron-trapping and energy localization in insulating materials. Technological impact of space charge electron-beam characterization, AIP Advances 8:2018:095228

M. Autzen, A. S. Murray, G. Guérin, L. Baly, C. Ankjærgaard, M. Bailey, M. Jain, J.-P. Buylaert, Luminescence dosimetry: Does charge imbalance matter? Radiation Measurements 120(15):2018:26-32

T. E. Mølholt, R. Mantovan, H. P. Gunnlaugsson, K. Bharuth-Ram, M. Fanciulli, H. P. Gíslason, K. Johnston, Y. Kobayashi, G. Langouche, H. Masenda, D. Naidoo, S. Ólafsson, R. Sielemann, G. Weyer, Temperature and dose dependence of defect complex formation with ion-implanted Mn/Fe in ZnO, Physica B 404:2009:4820-4822,http://dx.doi.org/10.1016/j.physb.2009.08.187.

Presenter: AUTZEN, Martin

Session Classification: Opportunistic science - Results

Contribution ID: **43** Type: **not specified**

Results from chemistry experiments in 2017

Monday 15 July 2019 15:00 (20 minutes)

Chemical experiments with Mn-57 at ISOLDE CERN
Dedushenko S., Gunnlaugsson H., Larsen E., Olafsson S., Johnston K., Masenda H., Peters G., Schell J., Unzueta Solozabal I., Yablokov M., Zyabkin D., Bendix J., Bharuth-Ram K., Gisslasson H., Hemmingsen L., Krastev P., Langouche G., Mantovan R., Naidoo D., Perfiliev Yu., Qi B., ISOLDE Collaboration

ISOLDE, CERN

EMS is an important method for chemistry, allowing us to study cobalt and manganese compounds. For example, the decay of manganese presenting as permanganate-ion (MnO4-) could lead to unknown Fe +7 state.

First wet chemical experiments with short-lived Mn-57 (T1/2=85s) were conducted at ISOLDE CERN in June 2017. Mn+-particles were implanted into approx. 100 nm layer of manganese metal supported on copper foil. Then the layer was dissolved in sulfuric acid giving Mn2+-solution. The EMS pattern of the frozen solution undoubtedly corresponds to high-spin divalent iron and correlates with the known data for FeSO4 and CoSO4 frozen solutions. Oxidation of Mn2+ by NaBiO3 doesn't lead to any noticeable changes in the spectrum, despite the color change (from colorless to violet) which is clearly observed. Further chemical treatment of this solution by concentrated NaOH and, further, by sulfite leads to the observation of trivalent iron in the spectra, despite the respective color changes (from violet to green and, further, to brown with a sediment) observed. Isotopic exchange reactions were also performed.

The results obtained are analyzed in terms of the number of chemical forms of iron, the respective recoilless fractions, and the possibility of post-effects of the decay.

Presenter: DEDUSHENKO, Sergey K (Moscow Institute of Physics and Technology State University (RU)

Session Classification: Opportunistic science - Results

Contribution ID: **44** Type: **not specified**

Future chemistry experiments

Wednesday 17 July 2019 10:05 (20 minutes)

On the progress in automation of the chemical experiments with Mn-57
at ISOLDE CERN

Yu.K.Belov, S.K.Dedushenko, D.M.Levin, M.G.Tsepkov
Moscow, Russia
Mössbauer Collaboration Team
ISOLDE, CERN

First wet-chemical experiments with Mn-57 were conducted at ISOLDE in June 2017. They comprised multiple steps: placement of a piece of metallic foil (target) in the implantation chamber followed by its evacuation, accumulation of Mn-57 by ion-implantation into the foil, vacuum release and removal of the foil from the chamber, packaging and transportation of the foil to the chemical lab, unpackage the foil, dissolution of manganese layer from the foil by acid followed by the additions of chemicals to transform manganese into the desired chemical form, preparation of a sample for Mössbauer measurement including freezing of a solution, measurement, radioactivity waste and preparations for the next repetition.
To constrict the time lost, to improve the radiation safety, and to increase the efficiency of the experiments, we consider the automation of all steps of the experimental procedure.
The fast insertion/removal of the target into/from the implantation space without vacuum release can be performed by a valve mechanism [1].
To obtain maximum specific count rate with Mn-57 the valve should be turned approx. every minute, which seems acceptable time for the chemical treatment (e.g. permanganate synthesis) and accompanying manipulations (from unloading target from the valve to the sample preparation for the Mössbauer measurements).
The valve has been developed, manufactured, and tested for operation under vacuum. Its body is made of aluminium alloy, the rubbing surfaces being covered by alumina by MAO-technology (see e.g. [2]). Apiezon-L grease [3] is used for fine and hermetic turn.

[1] www.happysloth.ru/ISOLDE
[2] V.N.Malyshev, K.M.Zorin // Applied Surface Science 254(2007)1511-1516.
[3] www.apiezon.com/products/vacuum-greases

Presenter: DEDUSHENKO, Sergey K (Moscow Institute of Physics and Technology State University (RU)

Session Classification: Future shifts/proposals

Contribution ID: **45** Type: **not specified**

Hydrogenated anatase annealing with eMS

Monday 15 July 2019 17:15 (20 minutes)

Results obtained during the eMS beam time in 2017 on hydrogenated anatse titania. Spectra have shown an interesting behaviour, which turned out to be different in comparision to pristine samples.

Presenter: ZYABKIN, Dmitry (Technische Universitaet Ilmenau (DE))

Session Classification: Oxides - Results

Contribution ID: **46** Type: **not specified**

eMIL: advanced emission Moessbauer spectrometer

Wednesday 17 July 2019 09:30 (15 minutes)

A look at the new setup for eMS experiments.

Presenter: ZYABKIN, Dmitry (Technische Universitaet Ilmenau (DE))

Session Classification: Future shifts/proposals

Contribution ID: **47** Type: **not specified**

eMIL: Discussions upon Equipment

Wednesday 17 July 2019 09:45 (20 minutes)

Talks over new ways how to perform advanced experiments by virtue of eMIL such as: advanced magnetic, cryogenic measuraments as well as measurament od electroconductivity and experiments performed under pressure in-situ.

Presenter: ZYABKIN, Dmitry (Technische Universitaet Ilmenau (DE))

Session Classification: Future shifts/proposals

Contribution ID: **48** Type: **not specified**

57Fe-eMS Results on Nanocrystalline Fe76Mo8Cu1B15

Tuesday 16 July 2019 12:15 (15 minutes)

57Fe emission Mössbauer measurements, carried out on virgin and annealed Fe76Mo8Cu1B15 nano-crystalline samples are presented in this talk. The discussion is focused on the role of the implantation-induced damage, and its effect on the atomic-scale magnetism.

Presenter: UNZUETA SOLOZABAL, Iraultza (Universidad del País Vasco / Euskal Herriko Unibertsitatea (ES))

Session Classification: Mn Alloys

Contribution ID: **49** Type: **not specified**

ISOLDE: Facility and Status

Monday 15 July 2019 09:35 (15 minutes)

Solid state Physics research at ISOLDE (CERN) has been running since the mid-1970s and accounts for about 10-15% of the overall physics programme. ISOLDE is the world flagship for the on-line production of exotic radioactive isotopes, with high yields, high elemental selectivity and isotopic purity. Consequently, it hosts a wide variety of state-of-the-art nuclear techniques which apply nuclear methods to research on life sciences, material science and bio-chemical physics. The ease of detecting radioactivity –< 1 ppm concentrations –is one of the features which distinguishes the use of radioisotopes for materials science research. The manner in which nuclear momenta of excited nuclear states interact with their local electronic and magnetic environment, or how charged emitted particles interact with the crystalline lattices allow the determination of the location, its action and the role of the selected impurity element at the nanoscopic state. ISOLDE offers an unrivalled range of available radioactive elements and this is attracting an increasing user community in the field of nuclear solid state physics research and brings together a community of materials scientists and specialists in nuclear solid state techniques [1].

This talk will present an overview of the ISOLDE facility, along with a brief introduction to the current nuclear physics programme before concentrating on the use of radioisotopes for solid state physics research.

[1] K. Johnston, J. Schell, J. G. Correia, M. Deicher, H. P. Gunnlaugsson, A. S. Fenta, E. David-Bosne, A. R. G. Costa and Doru C Lupascu, Journal of Physics G: Nuclear and Particle Physics, 44 (2017) 104001

Presenter: JOHNSTON, Karl (CERN)

Session Classification: Introduction

Contribution ID: **50** Type: **not specified**

Solid State Physics at ISOLDE

Monday 15 July 2019 09:50 (15 minutes)

The idea that "new-is-small"reflects a paradigm moving industries and research. New materials, new applications, new technologies, - but what do we need to make the "new", understandable, applicable and reliable? Clearly, as things go smaller and smaller, it is more difficult to probe at the appropriate scale without influencing the subject of interest. Ideally, one needs tip-less (contact-less) techniques, not interfering with the system under study. In fact, such an approach has been realized using nuclear probes, where radioactive nuclei interact with their surroundings in a solid on an atomic scale and transmit this information via their radioactive decay complementing current macroscopic techniques. Key microscopic features can be inspected in this way, such as lattice location, diffusion, interaction with defects present in the neighbourhood of the probe atom, magnetic properties, percolation phenomena leading to structural and magnetic phase transitions, doping and transport phenomena, such as you can find in bulk nanomaterials and near surfaces or interfaces. Since the late 70s researchers at ISOLDE have been applying radioactive nuclear techniques to materials science and biophysics research. A considerable infrastructure has been built up on-site to allow scientists to perform experiments using short-lived isotopes. The production of radioactive isotopes online with big yields, elemental and isotopic purity allow the choice of the right probe radioactive element / isotope adequate to study each problem. In this context, Deep Level Transient Spectroscopy and Photoluminescence with radioactive Isotopes and nuclear techniques such as Perturbed Angular Correlations, Emission Channeling, ß-Nuclear Magnetic Resonance, Secondary Ion Mass Spectroscopy, Spreading Resistance Profiling and Mössbauer are very powerful to characterize new materials, particularly from an atomic point of view. ISOLDE is the world reference on production and delivery of radioactive beams of high purity dedicated to many different purposes for, e.g., atomic, nuclear, solid state, biophysics, and medical research. This laboratory is also a pioneer in the use of nuclear techniques –with an enriched potential due to the wide number of available radioactive probe elements –while studying the atomic scale interactions of the probe nuclei with its neighbourhood. This contribution explores the Solid State Physics Program at ISOLDE, isotopes, projects, techniques and their development to analyse new materials.

Presenter: JOHNSTON, Karl (CERN)

Session Classification: Introduction

Contribution ID: **51** Type: **not specified**

Bismuth Ferrite BFO

Tuesday 16 July 2019 16:15 (15 minutes)

Bismuth Ferrite is the best studied room temperature multiferroic due to its potential applications as magnetoelectric memory and in magnetic sensing. Its magnetic order is a result of spin moment coupling of the iron ions. A modified G-type antiferromagnetism yields an effectively vanishing gross magnetization. Magnetic order in Bismuth Ferrite becomes intricate due to the formation of the incommensurate spin cycloid. This presentation reports on preliminary characterization data in Bismuth Ferrite.

Presenter: SCHELL, Juliana (Institut Fur Materialwissenschaft Universität Duisburg-Essen (D)

Session Classification: Oxides - Results

Contribution ID: **52** Type: **not specified**

IS611 overview: Study of molybdenum oxide by means of Perturbed Angular Correlations and Mössbauer spectroscopy

Monday 15 July 2019 16:35 (10 minutes)

Among transition-metal oxides, the Molybdenum oxide compounds are particularly attractive due to the structural (2D) anisotropy and to the ability of the molybdenum ion to change its oxidation state, being such properties well adequate for applications on, e.g., chemical sensors, solar cells, catalytic and optoelectronic devices. At ISOLDE we aim studying the incorporation of selected dopants by ion implantation, using the nuclear techniques of Perturbed Angular Correlations (PAC) and Mössbauer spectroscopy (MS). Both techniques make use of highly diluted radioactive probe nuclei, which interact –as atomic sized tips –with the host atoms and defects. The objectives of this project are to study at the atomic scale the probe's local environment, its electronic configuration and polarization, the probe's lattice sites, point defects and its recombination dynamics and, in the case of e-gamma PAC, the electron mobility on the host can be further studied, e.g., as a function of temperature.

Presenter: SCHELL, Juliana (Institut Fur Materialwissenschaft Universität Duisburg-Essen (D)

Session Classification: Oxides - Results

Contribution ID: **53** Type: **not specified**

Flakes of MoOx

Monday 15 July 2019 16:45 (10 minutes)

We report the angular dependence of the 2-dimensional α-MoO3 single crystals by emission Mössbauer Spectroscopy (eMS) via ion implantation via of 57Mn (t1/2 = 1.5 min) carried out at ISOLDE-CERN. In addition, scanning electron microscope analysis was carried out at room temperature.

Presenter: SCHELL, Juliana (Institut Fur Materialwissenschaft Universität Duisburg-Essen (D)

Session Classification: Oxides - Results

Contribution ID: **54** Type: **not specified**

Future Project BiFe

Wednesday 17 July 2019 11:00 (15 minutes)

Magnetoelectric coupling exists locally but is not observable macroscopically due to the antiferromagnetic order. We aim to submit a project to the INTC-CERN in order to use emission Mössbauer spectroscopy to study magnetoelectric coupling and the effect of implantation process in bismuth ferrite.

Presenter: SCHELL, Juliana (Institut Fur Materialwissenschaft Universität Duisburg-Essen (D)

Session Classification: Future shifts/proposals

Contribution ID: **55** Type: **not specified**

Magnetism (Mn3Ge, MnBi, MnAl)

Wednesday 17 July 2019 11:15 (15 minutes)

Possible studies related to new candidates considered to be alternatives to rare-earth-based hard magnetic materials. Several possible directions are going to be presented, studies can be done on basis of thin films.

Presenter: ZYABKIN, Dmitry (Technische Universitaet Ilmenau (DE))

Session Classification: Future shifts/proposals

Contribution ID: **56** Type: **not specified**

STO paper

Tuesday 16 July 2019 16:30 (10 minutes)

I will briefly tell about the status of a STO paper

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Oxides - Results

Contribution ID: **57** Type: **not specified**

Garnet structures studies following eMS. Results and perspectives.

Tuesday 16 July 2019 16:40 (15 minutes)

Synthetic crystalline garnets doped with the rare-earth elements are commonly used as a host materials in acoustic transmitters and numerous nonlinear optics applications because of their ability to generate ultra short pulses. 57Fe emission Mössbauer spectroscopy (eMS) following implantation of 57Mn (T½ = 1.5 min.) in the temperature range from 298 K to 798 K has been applied to study the lattice location and properties of Fe in three types of single crystal garnet structures: yttrium iron garnet Y3Fe5O12 (YIG), gadolinium gallium garnet Gd3Ga5O12 (GGG) and yttrium aluminium garnet (YAG, Y3Al5O12). The results show that introducing point defects by ion implantation is a possible method of tailoring magnetic properties in the ferromagnetic garnet system.

Presenter: KRASTEV, Petko (University of Sofia (BG))

Session Classification: Oxides - Results

Contribution ID: **58** Type: **not specified**

FeV status

Tuesday 16 July 2019 15:10 (5 minutes)

Presenter: GUNNLAUGSSON, Haraldur Pall (University of Iceland (IS))

Session Classification: Opportunistic science - Results

Contribution ID: **59** Type: **not specified**

eMS Results on BN

Tuesday 16 July 2019 14:05 (15 minutes)

Presenter: NAIDOO, Deena (University of the Witwatersrand)

Session Classification: Opportunistic science - Results

Contribution ID: **60** Type: **not specified**

eMS - Ge2Sb2Te5 Results

Tuesday 16 July 2019 15:00 (10 minutes)

Presenter: NAIDOO, Deena (University of the Witwatersrand)

Session Classification: Opportunistic science - Results

Contribution ID: **61** Type: **not specified**

Concluding remarks

Wednesday 17 July 2019 12:00 (20 minutes)

Plus conference photo

Session Classification: Future shifts/proposals

Contribution ID: **62** Type: **not specified**

Open discussion - future of eMS

Wednesday 17 July 2019 11:30 (30 minutes)

Session Classification: Future shifts/proposals

Contribution ID: **63** Type: **not specified**

Internal meeting of the Mössbauer collaboration at ISOLDE/CERN

Wednesday 17 July 2019 13:50 (1h 30m)

Things that need to be addressed:
- Publication rules
- Group structure
- Committees
- FTP/WEB etc

Contribution ID: **64** Type: **not specified**

Internal meeting of the Mössbauer collaboration at ISOLDE/CERN

Wednesday 17 July 2019 15:40 (1h 30m)

Things that need to be addressed:
- Publication rules
- Group structure
- Committees
- FTP/WEB etc