EMIR Federation: Network of Accelerators Dedicated to Material irradiation

Serge BOUFFARD, EMIR Federation and CIMAP

EMIR Federation, CIMAP-GANIL, CEA-CNRS-ENSICAEN-UNICAEN (Caen, France)

The ageing under irradiation of the materials involved in nuclear power industry is a well known problem which has been extensively studied over several decades. These studies driven by industrial requirements cover all the continuum of the approaches from atomic scale to the technologic tests. All along the nuclear fuel cycle, materials are damaged by different particles: chemical additives in fuel synthesis, the components of nuclear reactors, materials for the waste disposals and of course the nuclear fuel. In all cases, irradiation induced aging of the materials is a very important factor to be taken into account for safety reasons and economic considerations. These are the reasons why the study of materials under irradiation remains a major concern.

Understanding the processes of the damage of metals has made significant progress in recent years thanks to the development of the simulation and new experimental approaches. However, much remains to be done to obtain predictive simulations of the industrial materials in operating conditions. Moreover, for iono-covalent ceramics, knowledge on the dynamic of defects remains much patchy. For these materials, an important effort must be done at all temporal and spatial scales to reach the knowledge level of metallic alloys. This must be also done for the organic materials.

Despite this, the French research potential in the field of materials under irradiation remains relatively low. Given this relative weakness of the means of irradiation and online characterizations, six accelerator platforms have created a network with the objective to coordinate their instrumental developments and the access to the experimental facilities. This network which belongs to many entities, has recently obtained the CNRS label of federation: federation of accelerators dedicated to material irradiation. This network consists of 6 platforms with unique equipments and specific expertises. Its objectives are the followings:

- promote experiments on materials under irradiation,
- networking the irradiation facilities,
- organize the service for external users,
- promote the developments of facilities in accordance of research evolution,
- scientific animation and training on material irradiation
- inform the organizations about these researches

The six platforms are:

- JANNUS	Saclay	CEA/DEN/DMN/SRMP;
- JANNUS	Orsay	CSNSM CNRS/IN2P3 – Paris-Saclay University;
- CEMHTI	Orléans	CNRS/INC;
- SIRIUS	Palaiseau	LSI CEA/DSM/IRAMIS, CNRS/INP, Ecole Polytechnique ;
- HVTEM	Saclay	CEA/DEN/DMN/SRMA;
- CIMAP/GANIL	Caen	CEA/DSM/IRAMIS, CNRS/INP, ENSICAEN, Caen University

Their specificities and their online characterization devices will be described as well as the statistics on the experimental proposal (distribution on requested beam, on subjects...)

The table below gives the main specificities of the platforms.

	specificities	In-situ characterizations
Ion accelerators		
JANNuS – Saclay – SRMP		
triple beams	irradiation and implantations simultaneously	in-situ RAMAN and RBS, NRA, ERDA
JANNuS – Orsay – CSNSM		
double beams	irradiation or implantation and TEM observation simultaneously	in-situ TEM and RBS
CEMHTI – Orléans		
high-energy light ions	large range	in-situ RBS and variable temperature Raman, mechanical stress
CIMAP – GANIL – Caen		
swift heavy ions	large range effects dominated by electronic excitations	in-situ X-ray diffraction, infrared and UV-visible spectroscopies, gas emission
Electron accelerators		
SIRIUS – LSI – Palaiseau		
2.5 MeV electron	large irradiated area energy range	in-situ : electric, magnetic, optic properties
HVTEM – SMRA – Saclay		
1 MeV electron	Irradiation inside a high voltage TEM	in-situ imaging of structural evolution, environmental electron microscope

EMIR network organizes an annual call for experimental proposals, the proposals are assessed by two external referees and an international scientific committee ranks the proposal from these assessments and their own opinion.

For more information: <http://emir.in2p3.fr/>

The EMIR facilities (from left to right): Jannus-Saclay, HVTEM, CEMHTI, CIMAP-GANIL, SIRIUS, Jannus-Orsay

EMIR FEDERATION

**NETWORK OF ACCELERATORS
DEDICATED TO MATERIAL IRRADIATION**

Serge Bouffard

EMIR federation & CIMAP

CEMHTI – CIMAP – CSNSM – LSI – SRMA – SRMP

Which accelerators?

Which accelerators?

6 MV Tandetron

HVEE

0.3 – 6 MV

12 End stations:

Implantation

Irradiation

Ion beam analysis

Mass spectroscopy

3 MV Tandetron

HVEE

0.15 – 3 MV

6 End stations:

Implantation

Irradiation

Ion beam analysis

Double beam experiment

2 MV Van den Graaff

0.4 – 1.8 MV

H, He

2 End stations:

Ion beam analysis

ionoluminescence

40 kV Ion Implanter

Danfysik

100 eV – 40 keV

1 chamber

implantation

200 kV Ion Implanter

Danfysik

20 – 200 keV

2 chambers

implantation

500 kV Ion Implanter

HVEE

10 – 500 keV

4 chambers

implantation

6 MV Tandetron

HVEE - 0.3 – 6 MV - 12 End stations

3 MV Tandetron

HVEE - 0.15 – 3 MV - 6 End stations

2 MV Van den Graaff

0.4 – 1.8 MV - H, He - 2 End stations

500 kV Ion Implanter

HVEE - 10 – 500 keV - 4 chambers

200 kV Ion Implanter

Danfysik - 20 – 200 keV - 2 chambers

40 kV Ion Implanter

Danfysik - 100 eV – 40 keV - 1 chamber

10 keV Colutron

H+He, connected with the 6MV Tandem to the TEM (triple beams)

350 keV HVEE implanter

H $\rightarrow$ Pb broad beam to single ion from -230 to 800°C
 μ beam : $\sim 1 \mu\text{m}$

NEC 1 MV Tandem

Implantation 6-inches and into TEM

NEC 3 MV Pelletron

Ion beam analysis
 μ beam: $\sim 150 \text{ nm}$

HVE 6 MV Tandem

Irradiation
In-situ electrical, optical, mechanical testing from -230 to 1200°C
 μ beam : $\sim 1 \mu\text{m}$

Radio Frequency Quadrupole Linac (RFQ)

Post-accelerates the ion of 6MV Tandem: 1.92 MeV/A

Takasaki Advanced Radiation Research Institute

Japan Atomic Energy Agency

TIARA (Takasaki Ion Accelerators for Advanced Radiation Application)

Takasaki Advanced Radiation Research Institute

Japan Atomic Energy Agency

Cyclotron H 7-90 MeV
Kr 70-520 MeV
3 MV tandem
3 MV VdG
400 keV ion implanter
2 MeV electron
 ^{60}Co

TIARA (Takasaki Ion Accelerators for Advanced Radiation Application)

EMIR Federation: a network of accelerators dedicated to material irradiation

Objectives

- Promotion of experiments on materials under irradiation,
 - Networking the irradiation facilities,
 - Organization of the service for external users,
 - Promotion of the developments of facilities in accordance of research evolution,
 - Scientific animation and training on material irradiation,
 - Information of the organizations about these researches

EMIR : *Etudes des Matériaux sous Irradiation*
Studies of Materials under Irradiation

Platform partners

- **CEMHTI - Orléans** (CNRS/INC, Université d'Orléans)
- **CIMAP - Caen** (CEA/DSM, CNRS/INP, ENSICAEN, Université de Caen)
- **CSNSM - Orsay** (CNRS/IN2P3, Université Paris-Sud)
- **LSI - Palaiseau** (CEA/DSM, CNRS/INP, École Polytechnique)
- **SRMP - Saclay** (CEA/DEN/DMN)
- **SRMA - Saclay** (CEA/DEN/DMN)

Supported by

- **CNRS**
 - **INP – INC – IN2P3**

EMIR platforms

ions			
JANNuS – Saclay – SRMP			
triple beams			
EPIMETHEE	3 MV	H→Bi	0.5 – 30 MeV
JAPET	2.5 MV	H→Bi	0.5 – 12 MeV
PANDORE	3 MV	H→He	0.5 – 3 MeV
JANNuS – Orsay – CSNSM			
in-situ TEM			
ARAMIS	H→Bi	0.5 – 15 MeV	
IRMA	H→Bi	5 – 570 keV	
CEMHTI			
high-energy light ions : large range			
Cyclotron	H→He	10 – 45 MeV	
VdG	H→He	0.5 – 3 MeV	
CIMAP – GANIL			
swift heavy ions : range, elect. excitation			
IRRSUD	C→U	10 – 90 MeV	
SME	C→U	160 – 700 MeV	

electrons		
SIRIUS – LSI		
large irradiated area		
SIRIUS	e-	0.15 – 2.5 MeV
HVTEM – SMRA		
in-situ TEM		
HVTEM	e-	1 MeV

EMIR platforms

EMIR platforms

EMIR platforms: in-situ instrumentation

ions
JANNuS – Saclay – SRMP
triple beams
Raman – RBS – NRA – ERDA
Irradiation: 77-800 K
JANNuS – Orsay – CSNSM
in-situ TEM
TEM – RBS – NRA
Irradiation: RT – 100-1200 K
CEMHTI
high-energy light ions: range
Raman – electrochemistry – c-RBS – NRA
Irradiation: RT – 170-1200°C
CIMAP – GANIL
swift heavy ions : range, elect. excitation
X-ray diffraction – infrared and UV-visible spectroscopies – time resolved iono-luminescence – gas emission
Irradiation: RT – 8-1400 K

electrons
SIRIUS – LSI
large irradiated area
electric, magnetic, optic properties – gas emission
Irradiation: 20-600 K
HVEM – SMRA
in-situ TEM
TEM
Irradiation: RT – 700°C

Les irradiations par particules chargées

- Machines multi-faisceaux
 - Ajustement appm/dpa - Spectre de PKA - Pas d'activation

– JANNUS	Saclay	(3 MV – 2.5 MV – 2.25 MV)	
– FZ	Dresden	(3 MV – 500 kV)	
– FSU	Iena	(3 MV – 400 kV)	
– JAERI	Takasaki	(3 MV – 3 MV – 400 kV)	
– HIT	Tokyo	(1.7 MV – 1 MV)	
– IAE	Kyoto	(1.7 MV – 1 MV – 1 MV)	
– DNE	Nagoya	(2 MV – 200 kV)	
– MSD	Kalpakkam	(1.5 MV – 150 kV)	
– Argonne		(2 MV – 300 kV)	TEM
– CSNSM	Orsay	(2 MV – 150 kV)	TEM

Organization

- **Steering committee**
 - **CNRS/INP, CNRS/IN2P3, CNRS/INC, CEA/DEN, CEA/DSM, Ecole Polytechnique, ENSICAEN, Universities of Caen and Paris-Saclay**
- **Executive committee**
 - **Platform directors**
- **Direction**
 - **Director : S. Bouffard**
 - **Deputy-Directors : J.A. Scarpacci – M.F. Barthe**
- **Scientific committee**

- **HVEE VdG 4 MV**

- H $\rightarrow$ Xe (500 keV $\rightarrow$ 4 MeV)
- c-RBS, ERDA, NRA, PIXE
- Implantation / irradiation RT $\rightarrow$ 600°C

- **EATON implantor 200 kV**

- $\rightarrow$ In (10 keV $\rightarrow$ 200 keV)
- Implantation 10x10 cm², -150 $\rightarrow$ 600°C

Institut de Physique Nucléaire de Lyon

- **HVEE VdG 4 MV**

- H $\rightarrow$ Xe (500 keV $\rightarrow$ 4 MeV)
- c-RBS, ERDA, NRA, PIXE
- Implantation / irradiation RT $\rightarrow$ 1400°C

- **implantor 400 kV**

- H $\rightarrow$ Pb (70 keV $\rightarrow$ 400 keV)
- Irradiation / Implantation 50 cm², -150 $\rightarrow$ 600°C

How to get beam time on EMIR platform?

- Each platform is opened to external users for a fraction of its beam time.
- The access is attributed after an evaluation by a scientific committee
 - The proposals are assessed by 2 referees and by the scientific committee
 - The proposals are ranked A, B, C
 - The final decision is of the responsibility of the platform directions
- One call per year
 - The next call will open on December 7th

work for the collectivity,
become a referee.
Sign up on the EMIR website

Scientific committee

- **Eduardo Alves** Instituto Tecnológico e Nuclear, Lisboa
- **Emmanuel Balanzat** CIMAP, Caen
- **Alain Barbu** CEA/DEN/DMN
- **Pascal Bellon** University of Illinois (President)
- **Stephen Donnelly** University of Huddersfield, West Yorkshire
- **Gérard Panczer** IML, Lyon
- **Robin Schaeublin** Centre of Research in Plasma Physics, PSI
- **Christina Trautmann** GSI, Materials research, Darmstadt
- **Thierry Wiss** Institute for Transuranium Elements, Karlsruhe

- One third will be changed for the next meeting

Number of proposals

nationality of spokespersons

Subjects of the proposals

Subjects of the proposals

Subjects of the proposals

Common web site

<http://emir.in2p3.fr>

The next proposal call will be opened from
7/12/15 to 15/01/2016

Do'nt forget to register on the EMIR website

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EMIR: Etudes des Matériaux sous IRradiation

Emir - Réseau national d'accélérateurs pour les Etudes des Matériaux sous Irradiation

A NATIONAL NETWORK OF ACCELERATORS DEDICATED TO MATERIAL IRRADIATION
AND TO THE FUNDING OF ACADEMIC AND INDUSTRIAL RESEARCHERS TO ACCESS ITS 5 PLATFORMS

CNRS and CEA, in agreement with the French Ministry of Higher Education and Research, have set up a national network of accelerators dedicated to material irradiation. This network consists of 5 platforms with unique equipments and specific expertises.

Last news
» CAARI 2014 30-01-2014
» Call for proposals for 2014-2015 : deadline November 27th 23-10-2013
» Symposium dedicated to material irradiation 24-06-2013
» EMIR_users_days 2013 13-06-2013

Home page > Beam Time > Submitted proposals

Serge BOUFFARD (Log out) | Profile | Search

Submitted proposals

Here is a list of submitted proposals to EMIR.

ID	Facility	Submitted by	Experiment title	Status	Sci. Validation	Tech. Validation	Internal	Recommendation	CC Decision	Feedback	Cost	Done	Proposal Sheet
13-11-0017	CEMHTI	Jiachao Chen	THE EFFECTS OF HELIUM ON IASCC SUSCEPTIBILITY	Accepted	Sci. Reviews 1 2	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate
13-11-0108	LSI	Stéphane ESNOUF	RADIOLYSIS OF POLYMERS : TEMPERATURE EFFECT	Accepted	Sci. Reviews 1	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate
13-11-0182	CIMAP - GANIL	Gael SATTONNAY	Effects of electronic excitation in rare earth oxides	Accepted	Sci. Reviews 1 2	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate
13-11-0484	LSI	Ruslan Prozorov	EFFECT OF ELECTRON IRRADIATION ON MAGNETIC AND SUPERCONDUCTING STATE OF BAK122 SUPERCONDUCTORS ACROSS THE SUPERCONDUCTING DOME	Accepted	Sci. Reviews 1 2	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate
13-11-0859	LSI	Olivier GUILLOIS	CREATION OF SELF-INTERSTITIALS DEFECT IN VARIOUS DIAMOND SPECIMENS OF DIFFERENT STRUCTURAL QUALITY	Declined	Sci. Reviews 1 2	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate
13-11-1052	LSI	Dannoux-Papin Adeline	IRRADIATION OF GEOPOLYMERS AT HIGH DOSE RATE	Accepted	Sci. Reviews 1	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate
13-11-1158	JANNUS Orsay - CSNSM	Camille Flament	IN-SITU TEM STUDY OF THE STABILITY OF β'' (~MG5516) NANO-PRECIPTATES IN 6061-T6 ALUMINUM ALLOY	Accepted	Sci. Reviews 1 2	Tech. Review	☐	Read SC review	Post CC Decision	Files	0	☐	Generate

**Serge Bouffard
Fédération EMIR
CIMAP – GANIL
Bd Henry Becquerel
14070 Caen cedex**

serge.bouffard@cea.fr

<http://emir.in2p3.fr>