HAL
open science

Polymers degradation under radiolysis : experimental adaptations of devices for irradiating samples dedicated to analytical methods perspectives.

J. L. Roujou, M. Ferry, D. Durand, V. Dauvois, S. Esnouf, Y. Ngono-Ravache, M. Cornaton, S. Legand, Jm. Ramillon

To cite this version:

J. L. Roujou, M. Ferry, D. Durand, V. Dauvois, S. Esnouf, et al.. Polymers degradation under radiolysis : experimental adaptations of devices for irradiating samples dedicated to analytical methods perspectives.. IRAP 2016 - The 12th meeting of the “Ionizing radiation and polymers” symposium, Sep 2016, Giens, France. hal-02441965

HAL Id: hal-02441965

https://cea.hal.science/hal-02441965v1

Submitted on 16 Jan 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

POLYMERS DEGRADATION UNDER RADIOLYSIS : ADAPTATIONS OF DEVICES FOR IRRADIATING SAMPLES DEDICATED TO ANALYTICAL METHODS PERSPECTIVES.

J.L. Roujou[1], M. Ferry[1], D. Durand[1], V. Dauvois[1], S. Esnouf[1], Y. Ngono-Ravache[2], M.Cornaton[1], S. Legand[1] , J.M. Ramillon[2]

[1] CEA, DEN, DPC, SECR, LRMO, F-91191 Gif-sur-Yvette, France. [2]CIMAP, UMR CEA-CNRS-ENSICAEN-UCBN, BP 5133, F-14070 Caen cedex 5, France.

IRaP 2016 THE 12TH INTERNATIONAL SYMPOSIUM ON IONIZING RADIATION & POLYMERS

General context

- In the French nuclear safety context for managing waste packages long term behavior.
- Main objectives are analytical determination of degradation products generated after radiolysis.
- Various organic or inorganic materials, including polymers =
  - Production of potentially, explosive (hydrogen, methane…) or corrosive (HCl, HF,…) gases.
  - Chemical changes of the organic matter in waste packages due to radiations and evolution of interactions in the storage.

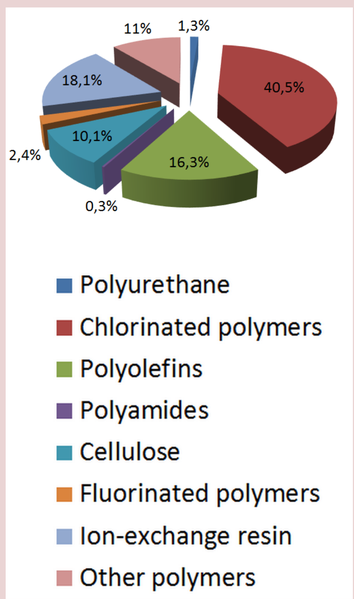
Studies context

- Problems have to be solved to obtain reliable data for long term predictions.
- Quantification of the gaseous compounds release, as a function of a ratio polymer/dose
  - Doses frequently higher than tens or one hundred of MGy => chemical composition of organic materials highly modified.
- Studies of materials under various irradiation conditions : various atmospheres, temperatures and different ionizing sources.

Preparation of adapted devices for irradiation and analysis :

SAMPLE	Polymers and additives as needed for determination of radiolysis interactions	Easy introduction and recovering of the polymer for solid analysis
ATMOSPHERE	Filling with well known, selected (composition and pressure) gases.	Direct injection in mass spectrometer of experimental atmosphere for gas analysis
IRRADIATION	Dose deposition at various temperatures, reliable with reproductible conditions experiences.	A panel of volumes and wall thickness with interactions as lower as possible.

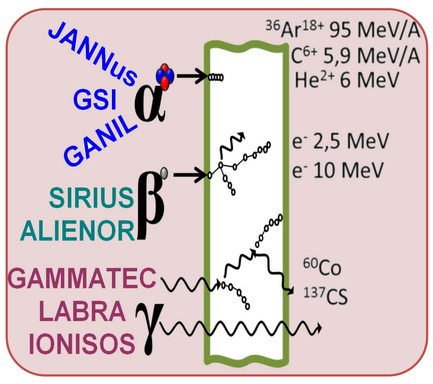
Polymers used in French electronuclear industry



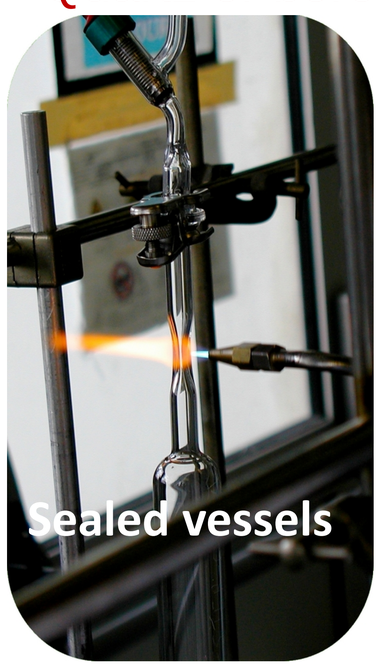
Other molecules of interest

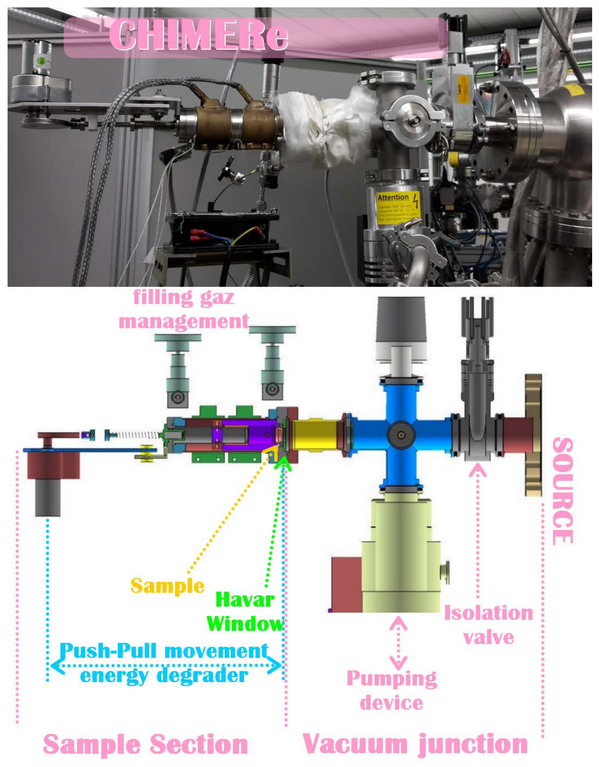
- Stearates
- Nitric acid
- Water
- Molecules used in nuclear industry

Many collaborations



Quartz or borosilicated glass vessels.





Dose deposition in accordance with specific kind of the irradiating beam.

Doses consistent with waste storage different terms.

Managing the sample in accordance with the analytical objective, even more dealing with gas analysis and studying the influence of the irradiation dose on gas emission and/or oxygen consumption.

Analytical specialities found in DPC-LRMO

FTIR	COT	DART-MS
TGA-DSC	IC	TD-GC-MS
HR-MS	Gas Expertise	ASAP-MS

Managing with material + radiation interactions to focus the analytical result on the real objective.
Dose deposition controlled, known atmosphere and pressure measurements realized, sample preparation (form, quantity, post gas analysis recovering of irradiated material), possible analyses of labile and solid compounds.

Perspectives

Contribution to database creation of the polymers radiation chemical yields with the improved knowledge in gas analysis of the DPC LRMO laboratory.

Contacts

Jean-Luc Roujou: jean-luc.roujou@cea.fr
Vincent Dauvois: vincent.dauvois@cea.fr