

# PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 41st cycle

### THEMATIC Research Field: RADIOCHEMISTRY AND RADIATION CHEMISTRY FOR NUCLEAR WASTE MANAGEMENT

Monthly net income of PhDscholarship (max 36 months)	
1300.0	
In case of a change of the welfare rates during the three-year period, the amount could be modified.	

Com	text of the research activity
Motivation and objectives of the research in this field	<ul> <li>The nuclear industries and technologies are continuously evolving in a perspective of reliable, safe, sustainable, and transparent development. In particular, there is need for innovation and research for ensuring the safe implementation of decommissioning and waste management, as clearly demanded by the industry and the scientific community.</li> <li>This research addresses current environmental and safety issues arising from the production of energy by nuclear fission and the industrial exploitation of ionizing radiation. In particular, the main research lines are:</li> <li>1. advanced recycling of spent nuclear fuel (SNF) by means of hydrometallurgical processes aiming at separating actinides and fission products from high active raffinate coming from PUREX or PUREX-like processes: study of innovative and sustainable solutions;</li> <li>2. radiation damage on organic systems for SNF reprocessing and inorganic matrices for confinement: comprehension of the degradation mechanisms and technological impact;</li> <li>3. development of innovative, sustainable and low-cost matrixes for radioactive waste conditioning;</li> <li>4. radio-induced modifications on materials for radiation</li> </ul>

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determination.		<ul> <li>processing, on dosimetric systems for medical applications, on active pharmaceutical ingredients, on food: comprehension of the degradation mechanisms and technological impact;</li> <li>5. new treatment and decontamination processes for radioactive waste;</li> <li>6. advanced radiochemical methods for radioactive contaminants and hard-to-measure radionuclides determination.</li> </ul>
<ul> <li>Methods and techniques that will be developed and used to carry out the research</li> <li>Methods and techniques that will be developed and used to carry out the research</li> <li>The research activity foresees a relevant experimental part with a strong multidisciplinar and interdisciplinary nature. Several methdos and techniques could be used for investigating the different aspects under study, such as: <ol> <li>Solvent extraction for actinide/lanthanide/fission products separation.</li> <li>Nuclear measurements and analytical chemistry techniques (ICP-MS, ICP-OES, LSC, UV-VIS, NMR, ESI-MS etc.) for fuel partitioning studies.</li> <li>Raman spectroscopy, X-ray fluorescence and diffraction, SEM, tomography, mechanical-thermal-irradiation-leaching resistance tests for characterization of waste confinement matrices.</li> <li>irradiation by gamma ray, HPLC, MS, NMR and EPR spectroscopy for radiolytic products characterization.</li> <li>GPC, PALS, FT-IR and EPR for materials study,</li> <li>UV-VIS and MRI for absorbed dose measurement.</li> <li>FT-IR, Raman XRD, XRF, SEM, TGA, GC-MS, ICP-MS, ICP-OES, etc. for the characterization of treatme processes.</li> <li>Radiochemical methods for Nucl. Decommissioning, incl. Nuclear measurements techniques (alpha spectrometry, LSC, ICP-OES, ICP-MS etc.)</li> <li>In addition, some computational tools (e.g. Monte Carlo and Density Functional Theory) may be employed for</li> </ol></li></ul>	Methods and techniques that will be developed and used to carry out the research	<ul> <li>The research activity foresees a relevant experimental part with a strong multidisciplinar and interdisciplinary nature. Several methdos and techniques could be used for investigating the different aspects under study, such as:</li> <li>1. Solvent extraction for actinide/lanthanide/fission products separation.</li> <li>2. Nuclear measurements and analytical chemistry techniques (ICP-MS, ICP-OES, LSC, UV-VIS, NMR, ESI-MS etc.) for fuel partitioning studies.</li> <li>3. Raman spectroscopy, X-ray fluorescence and diffraction, SEM, tomography, mechanical-thermal-irradiation-leaching resistance tests for characterization of waste confinement matrices.</li> <li>4. irradiation by gamma ray, HPLC, MS, NMR and EPR spectroscopy for radiolytic products characterization.</li> <li>5. GPC, PALS, FT-IR and EPR for materials study,</li> <li>6. UV-VIS and MRI for absorbed dose measurement.</li> <li>7. FT-IR, Raman XRD, XRF, SEM, TGA, GC-MS, ICP-MS, ICP-OES, etc. for the characterization of treatment processes.</li> <li>8. Radiochemical methods for Nucl. Decommissioning, incl. Nuclear measurements techniques (alpha spectrometry, LSC, ICP-OES, ICP-MS etc.)</li> <li>In addition, some computational tools (e.g. Monte Carlo and Density Functional Theory) may be employed for</li> </ul>



	evaluations/simulations.
Educational objectives	The PhD candidate will develop high-qualified skills and a solid expertise in radiochemistry, radiation chemistry and nuclear waste management, with a focus on the abovementioned research fields. The PhD candidate will be able to tackle multidisciplinary and complex issues, taking advantages from the new nuclear laboratories, equipment, facilities and the strong experimental background of the research group. The constant exchange and collaboration with international companies and research organizations (EURATOM/H2020, IAEA, JPNM-EERA, ENEN2Plus Collaborative Projects) will allow the student to interact with a stimulating scientific context and to develop critical thinking.
Job opportunities	In the field of nuclear and chemical activities for energy production and Gen IV systems; national and European industries involved in nuclear decommissioning, management and disposal of nuclear and industrial radioactive waste; International Research Centres.
Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 4 PhD Students
Name of the research directors	Mariani Mario, Macerata Elena, Mossini Eros

Contacts	
mario.mariani@polimi.it:	
+39 02 2399 6358	
elena.macerata@polimi.it;	
+39 02 2399 6358	
eros.mossini@polimi.it	
+39 02 2399 6395	
http://www.radiochimica.polimi.it	
https://www.youtube.com/channel/UCKh-HxSAWYhhNX076uuvTOA	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	
Housing - Out-of-town residents	3/

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Scholarship Increase for a period abroad		
Amount monthly	650.0 €	
By number of months	6	

Stage and period abroad	
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	0

## Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Teaching assistantship:

availability of funding in recognition of supporting teaching activities by the PhD student There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations. Computer availability:

individual use +shared use (server)

Desk availability:

individual use

Awards:

Awards will be recognized to the PhD candidate up to Euro 2000,00 (gross amount) per year, in case of exceptional achievements in the research project (modelling tools, scientific papers, etc..), subject to the evaluation of the research director.