Proposition de sujet de thèse CNRS-L/UPPA

2019-2020

II. Fiche de Renseignements sur le laboratoire d'accueil au Liban

Université ou centre de recherche : Conseil National de la Recherche Scientifique

Laboratoire d'accueil : Centre National des Sciences Marines

Nom du Directeur du laboratoire : Milad Fakhri

Adresse : Jounieh, Lebanon

Boite postale : 189

Tél./Fax/Mél : +9619934763 ; +9613496680

Faculté ou organisme auquel est affilié le laboratoire d'accueil :

Nom du Directeur de thèse : Milad Fakhri

Le Directeur de thèse fait-il partie du laboratoire d'accueil : **X** Oui / ☐ Non

Si non, précisez son rattachement et ses coordonnées :

- Principaux thèmes de recherche de l'équipe où sera effectué le travail de thèse :
-
- Liste des publications récentes de l'équipe (pertinentes au sujet proposé- 3 dernières années) :

La thèse sera-t-elle effectuée en co-tutelle ou co-direction : En co-direction

III. Fiche de Renseignements sur le laboratoire d'accueil à l'UPPA

Laboratoire d'accueil : IPREM

Nom du Directeur du laboratoire : Ryszard Lobinski

Adresse : Hélioparc, 2, Avenue Angot

Code postale-Ville : 64053 Pau

Tél./Fax/Mél : +33 559 0 77 55

Ecole doctorale auquel est affilié le laboratoire d'accueil : ED211

Nom du Directeur de thèse : Joanna Szpunar

Le Directeur de thèse fait-il partie du laboratoire d'accueil : **x** Oui / □ Non

Si non, précisez son rattachement et ses coordonnées :

Nombre de thèses dirigées (ou co-dirigées) actuellement : 4

Pour les cinq dernières années, précisez les thèses soutenues, la durée en mois pour chacune d'entre elle, la liste des publications et la situation actuelle de chaque diplômé.

2014 (36 mois) PRACHA CHEAJESADAGUL- Researcher at the Petroleum Products and Alternative Fuels Research Department, PTT Research and Technology Institute, 71 Moo2 Phahonyothin Rd., Sanubtub, Wangnoi, Ayutthaya 13170 THAILAND

1. Cheajesadagul, P., Arnaudguilhem, C., Shiowatana, J., Siripinyanond, A., Szpunar, J., Discrimination of geographical origin of rice based on multi-element fingerprinting by high resolution inductively coupled plasma mass spectrometry, Food Chemistry 2013, 141(4):3504-9 DOI: 10.1016/j.foodchem.2013.06.060

2. Cheajesadagul, P., Shiowatana, J., Siripinyanond, A., Szpunar, J., Rice, in : Comprehensive Analytical Chemistry, Food Protected Designation of Origin — Methodologies and Applications, Chapter: Rice, Publisher: Elsevier, Editors: Miguel de la Guardia, Ana Gonzalez Illueca, 2013, pp.623-655

3. Cheajesadagul, P., Bianga, J., Arnaudguilhem, C., Lobinski, R., Szpunar, J. , Large-scale speciation of selenium in rice proteins using ICP-MS assisted electrospray MS/MS proteomics. Metallomics : integrated biometal science. 2014, 6, 646-653 doi:6. 10.1039/c3mt00299c.

Principaux thèmes de recherche de l'équipe où sera effectué le travail de thèse :

- Le développement de connaissances fondamentales en physico-chimie, chimie analytique et microbiologie, en relation avec des applications concernant la structure du vivant.
- La gestion de l'environnement et les propriétés fonctionnelles de différentes classes de matériaux.

Liste des publications récentes de l'équipe (pertinentes au sujet proposé) :

Issart, A., Godin, S., Preud'homme, H., Bierla, K., Allal, A., Szpunar, J., Direct screening of food packaging materials for post-polymerization residues, degradation products and additives by liquid extraction surface analysis nanoelectrospray mass spectrometry (LESA-nESI-MS), (2019) Analytica Chimica Acta, 1058, pp. 117-126.

Gigault, J., Halle, A.T., Baudrimont, M., Pascal, P.-Y., Gauffre, F., Phi, T.-L., El Hadri, H., Grassl, B., Reynaud, S. Current opinion: What is a nanoplastic? (2018) Environmental Pollution, 235, pp. 1030-1034.

Kińska, K., Jiménez-Lamana, J., Kowalska, J., Krasnodębska-Ostręga, B., Szpunar, J., Study of the uptake and bioaccumulation of palladium nanoparticles by Sinapis alba using SP ICP-MS, (2018) Science of the Total Environment, 615, pp. 1078-1085.

Kubica, P., Vacchina, V., Wasilewski, T., Reynaud, S., Szpunar, J., Lobinski, R., Rapid ion-exchange matrix removal for a decrease of detection limits in the analysis of salt-rich reservoir waters for fluorobenzoic acids by liquid chromatography coupled with tandem mass spectrometry, (2017) Analytical and Bioanalytical Chemistry, 409 (4), pp. 871-879.

Jiménez-Lamana, J., Wojcieszek, J., Jakubiak, M., Asztemborska, M., Szpunar, J., Single particle ICP-MS characterization of platinum nanoparticles uptake and bioaccumulation by: Lepidium sativum and Sinapis alba plants, (2016) Journal of Analytical Atomic Spectrometry, 31 (11), pp. 2321-2329.

Bierła, K., Riu, A., Debrauwer, L., Zalko, D., Bouyssiere, B., Szpunar, J., Screening for polybrominated diphenyl ethers in biological samples by reversed-phase fast HPLC-ICP MS, (2010) Journal of Analytical Atomic Spectrometry, 25 (6), pp. 889-892.

Mounicou, S., Szpunar, J., Lobinski, R., Inductively-coupled plasma mass spectrometry in proteomics, metabolomics and metallomics studies, (2010) European Journal of Mass Spectrometry, 16 (3), pp. 243-253.

Jiménez-Lamana, J., Laborda, F., Bolea, E., Abad-Álvaro, I., Castillo, J.R., Bianga, J., He, M., Bierla, K., Mounicou, S., Ouerdane, L., Gaillet, S., Rouanet, J.-M., Szpunar, J., An insight into silver nanoparticles bioavailability in rats, (2014) Metallomics, 6 (12), pp. 2242-2249.

IV. Sujet de thèse

A faire signer obligatoirement par tous les co-directeurs

IV.1. Titre

Innovative analytical methods for determining the role micro- and nano-plastics in the transport of contaminants in the marine environment

Méthodes analytiques innovantes permettant de déterminer le rôle des micro- et nano-plastiques dans le transport de contaminants dans le milieu marin

*La thèse fait-elle partie d'un projet de recherche financé par le CNRS-L : ☐ Oui / ☐ Non

Si oui, précisez :

Projet de recherche GRP CNRS-L/UL en cours :

Chercheur principal:

*La thématique sous laquelle s'inscrit la thèse fait-elle partie des priorités de cet appel pour l'année 2019-2020 (voir annonce): ☒ Oui / ☐ Non

Si oui, précisez (possibilité de choisir plus qu'une) :

- Environnement

Si non, définir une:

IV.2. Résumé (ne pas dépasser 200 mots)

Lebanon, like many Mediterranean coastal areas, is facing the consequences of rapid expansion of the urban areas with the increase of human activities. In the absence of operational wastewater treatment plants, effluents from coastal agglomerations are directly discharged into the sea while those from inland communities are disposed in rivers and streams, carrying different types of pollutants including particles of natural and anthropogenic origin that may serve as a carrier for a wide range of contaminants. The particular attention should be directed to the largely unexplored problem of micro- and nanoplastics which have a large surface area to volume ratio and show high affinity to organic molecules of anthropogenic origin such as pesticides, herbicides, drugs and personal care products. The project proposes the development of analytical methodologies for the assessment of plastic pollution of selected Lebanese coastal areas and analysis of the nature of contaminants transported by plastic micro and nanoparticles. This will give the opportunity to understand the impact of plastics in the possible contamination of marine environment

(water, sediments and biota) by emerging organic contaminants transported by micro and nanoplastics and evaluate possible health risks for high level consumers of marine products.

IV.3. Contexte et problématique (ne pas dépasser 200 mots)

Plastic is the most significant marine litter in the World accounting for 60- 80% of the total marine debris. Although a major portion of the plastic litter accumulates in open ocean surface waters, shoreline debris is an important source of plastic exposure to aquatic organisms and as much as 50-80% of the shoreline debris is plastic [1]. The interaction of public landfills located on the coast of some major cities of Lebanon with coastal dynamics (storm, strong waves, and torrential rain) as well as the discharged of domestic waste water in rivers, water streams and seawater without prior treatment lead not only to the flow of soluble pollutants but also to the invasion of sea water, beaches and benthic sediment with solid wastes of different sizes (macro, micro and nano) and their integration in the nutrient chain of multiple marine species. A large surface area to volume ratio of micro- and nanoplastics make them extremely acting as reservoirs of toxic chemicals into the environment. The evaluation of the pollution level, transport and biodisponibility of contaminants mediated by debris of plastics is of utmost importance.

[1] Thompsonet al., Ph. Trans. RSC B, Biol.Sci. 2009, 364, 2153)

IV.4. Descriptif des objectifs et de l'impact (ne pas dépasser 200 mots)

The primary objective of the project is the comprehensive assessment of macro-, micro and nanoplastic pollution at selected coastal areas of Lebanon and their role in the transport of organic pollutants.

The initial task will involve the development of a dedicated sampling protocol and a protocol for separation of the different fractions of plastic debris. It will include the determination of the size (macro/micro/nano), composition (polymer matrix) and the behavior towards other contaminants (Trojan horse effect) depending on the size and composition.

The special focus of the project will be the transport of emerging organic contaminants (pesticides, herbicides, drugs, personal care products) by plastic debris and its transfer to aquatic biota. Following the lack of precise information about the types of contaminants that may be transported by the microplastics, and their disintegrated form the nanoplastics, the project will identify and quantify the species present in individual fractions using HPLC/UPLC-ESI Orbitrap MS/MS. Plastics found in surface sea water, sediments and some defined marine species along the Lebanese coast, and characterized by GC pyrolysis MS, will be investigated. The results are expected to elucidate the role of plastic pollution in the "Trojan horse" phenomenon and its environmental and health risks.

IV.5. Aspect appliqué et/ou aspect innovateur (ne pas dépasser 200 mots)

The assessment of microplastics and their desintegrated form the nanoplastics distribution in the Lebanese marine environment and their contribution to the transport of various types of contaminants will be considered a pioneer study in this area of the Levantine basin. It will be the first research work in Lebanon to treat the level of plastic particles toxicity toward the marine ecosystems. The use of HPLC/UPLC-ESI Orbitrap MS/MS will be an innovative method in identifying the pollutants found in the particles of plastics. GC pyrolysis MS will be considered a strong tool for the characterization of plastics found in the marine ecosystems.

IV.6. Etat des recherches dans le domaine avant la thèse (ne pas dépasser 200 mots) + Ref. Bibliographiques

Plastic has a high persistence rate due to its long polymeric chains, its degradation demands time, yet it can be fragmented into smaller pieces by various degradation processes, photo-degradation, thermo-degradation, mechanical degradation leading to the formation of microplastic [1]. Its low rate of degradation, and its mobility makes it the perfect transmitter of contaminants and pollutants [2]. Macroplastics are usely responsible for the entaglement of marine life while as microplastics are easily ingested in big amounts by organisms. Their surface can absorb toxic contaminants , the contaminant is attached to the microplastic's surface. it can also desorb toxic contaminants that have been added during their production [3]. This feature helps in the transportation of various hydrophobic organic chemicals a long distance, making them the main transporter of persistant organic polluants (POPs) Chemicals that are either added to the plastic to enhance its performance or absorbed by the plastic can affect the viability of some population, interfering with its endocrine functions [4]. Retardants, for reduction of flammability can be a danger to children's health, it can be transferred through breast milk or food [5].

[1]Filgueiras A, Gago J, Pedrotti ML. Standardised protocol for monitoring microplastics in seawater. 2018;(February). doi:10.13140/RG.2.2.14181.45282

[2]Piperagkas O, Papageorgiou N, Ioannis K. Qualitative and quantitative assessment of microplastics in three sandy Mediterranean beaches, including different methodological approaches. *Estuar Coast Shelf Sci*. 2019;219(February):169-175. doi:10.1016/j.ecss.2019.02.016

[3]Greenpeace. A Mediterranean full of plastic. 2017:16.

[4]Fossi MC, Coppola D, Baini M, et al. Large filter feeding marine organisms as indicators of microplastic in the pelagic environment: The case studies of the Mediterranean basking shark (Cetorhinus maximus) and fin whale (Balaenoptera physalus). *Mar Environ Res*. 2014;100(September):17-24. doi:10.1016/j.marenvres.2014.02.002

[5]Engler RE. The complex interaction between marine debris and toxic chemicals in the ocean. *Environ Sci Technol*. 2012;46(22):12302-12315. doi:10.1021/es3027105

IV.7. Programme de recherche prévu pour la thèse et contribution des différents partenaires (ne pas dépasser 200 mots)

The Lebanese research team will be responsible of selecting an area to be studied and designing a sampling plan

The French team will take care of the method development for the analysis of the fractions of plastics by LC MS/MS and validation.

IV.8. Calendrier prévisionnel des mobilités

Months 1 to 6 (Beirut)

Bibliographic survey, the choice of sampling points and sampling campaign, fractionation of plastics according to their size: macro-, micro-, nanoplastics.

Months 7 to 12 (Pau)

Method development and validation for the selected pollutants in plastic fractions: organic contaminants and their degradation products. Analysis of real samples by means of chromatographic methods coupled to spectrometric detection.

Months 13 to 18 (Beirut)

Statistical and chemometric data treatment for the obtained results, conducting a second sampling campaign following the results from the first one.

Months 19 to 30 (Pau)

Organic pollutants and analysis in samples.

Months 31 to 36 (Beirut)

Statistical and chemometric analysis of results, writing the manuscript and preparation for thesis defense.

IV.9. Diffusion/valorisation des résultats

The obtained results will be the subject of at least two publications in international journals. The student will present the results in international meetings in the form of poster or oral presentation.

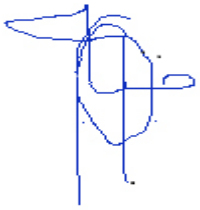
IV.10. Compétences requises

The student should have a master's degree in environmental or analytical chemistry. He/she should have a knowledge in chromatographic techniques. A knowledge of spectroscopic techniques, HPLC and MS would be advantageous. A good knowledge of English is required.

Date 7/5/2019

Noms et signatures (directeurs de thèse)

Joanna Szpunar ***Milad Fakhri***



Curriculum Vitae
Prof. Dr. Joanna Szpunar
July 2018

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64053 Pau, FRANCE
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Fax: + 33 559 40 76 81
e-mail : joanna.szpunar@univ-pau.fr

Academic qualifications

1986	engineer in chemical technology, Warsaw University of Technology, Poland
1986	M. Sc. in inorganic chemistry, Warsaw University of Technology, Poland
1992	Ph. D. in analytical chemistry, University of Warsaw, Poland
2000	D.Sc. (*habilitation*) in chemistry, University of Warsaw, Poland
2007	Professor in chemistry, 2007, Poland

Positions held

1987-1992	contractual engineer at the University of Warsaw, Poland
1993–1994	post-doctoral research fellow at the University of Antwerp (U.I.A.), Belgium
1995-1997	post-doctoral research fellow of the European Environmental Research Organization (EERO) at the University of Bordeaux, France
since 1997	research engineer at the French National Research Council (CNRS, Pau, France)

Research interests

Bioinorganic speciation analysis and hyphenated techniques for metallomics

Other

She is author or co-author of a book and more than 150 articles in journals indexed in WOS with an H-factor of 6&. Her publications have received more than 9150 citations (Google Scholar). She has supervised 12 PhD theses. She is Fellow of the Royal Society of Chemistry, member of the Advisory Boards of Journal of Analytical Atomic Spectrometry, Metallomics and Separations. In 2017 she was awarded with the prestigious European Award for Plasma Spectrochemistry. Joanna Szpunar has given in more than 45 plenary and invited lectures at international meetings.

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Curriculum Vitae

About me

I am working on monitoring the seawater pollution along the Lebanese coast. As well as I am running many studies concerning the variability of biogeochemical properties of marine sediment in front of rivers mouths and wastewater treatment plants. I am participating in geophysical campaigns for the elaboration of bathymetric maps for the coastal Lebanese water. My main field of interest is the monitoring of the variation of water column characteristics throughout seasons. I am operating two types of ROV during archeological campaigns for the exploration of ancient shipwrecks. I have some trials for the development of locally made GSM operated drifters to study the local surface currents by applying the Lagrangian method in front of the Lebanese shore line.

Qualifications

2005 PhD in Environmental Biosciences, Chemistry and Health. University of the Mediterranean (Aix Marseille II), France
1996 Master of Science diploma in Horticulture. CIHEAM- Mediterranean Agronomic Institute of Chania, Crete, Greece
1994 DSPU-Post Graduate Studies diploma in Horticulture. CIHEAM- Mediterranean Agronomic Institute of Chania, Crete, Greece
1993 Agricultural Engineering diploma. Lebanese University, Faculty of Agricultural Sciences, Beirut, Lebanon

Career

2016 onwards Director of the National Centre for Marine Sciences – CNRSL
2006-2016 Researcher at the National Centre for Marine Sciences – CNRSL
1996-2006 Research Assistant-Engineer at the National Centre for Marine Sciences - CNRSL
2009 onwards Manager of the Lebanese Research Vessel CANA-CNRS, Lebanon
2007 onwards Professor of Oceanography & Cetology at the Lebanese University

Most significant references

1-Hassoun, A., **Fakhri,** M., Raad, N., Abboud-Abi Saab, M., Gemayel, E., DeCarloc, E. H., 2019. The carbonate system of the Eastern-most Mediterranean Sea, Levantine Sub-basin: Variations and drivers. *Deep-Sea Research Part II.*

2-Fakhri, M.**,** Ghanem, A., Ghsoub, M., Ghaith, A. 2018. Environmental status of the Bay of Jounieh through the evaluation of its marine sediments' characteristics. Lebanese Science Journal. 19(3): 373-388

3-Issa, L., Brajard, J**., Fakhri,** M., Hayes, D., Mortier, L., Poulain, P-M., 2016. Modelling surface currents in the Eastern Levantine Mediterranean using surface drifters and satellite altimetry. *Ocean Modelling*., 104: 1-14

4-Abboud- Abi Saab, M., **Fakhri**, M., Kassab, M-T., Matar, N., 2013. Seasonal and spatial variations of the dinoflagellate *Ostreopsis siamensis* in the Lebanese coastal waters (Eastern Mediterranean). *Cryptogamie, Algologie*., 34(1): 57-67

5-Fakhri, M., Abboud - Abi Saab, M., Khalaf, G., 2012. Water column contamination from discharge of wastewater treatment plant in south Beirut, Lebanon. *Journal of Environmental hydrology*., 20(17), 1-1

6-Abboud- Abi Saab, M., **Fakhri**, M., Kassab, M-T., 2012. Effect of chemical input on the temporal and spatial abundance of tintinnid ciliates in Lebanese coastal waters (Eastern Mediterranean). *Journal of the Black Sea / Mediterranean Environment*., 18(3), 299-328

7-Fakhri, M, Khalaf, G., Abboud - Abi Saab, M., Mouawad, R., Abi Chahine, C., Hamzé, M., 2011. Résultats préliminaires de l'impact des rejets d'une usine chimique sur l'environnement marin pélagique et benthique de la côte libanaise. *Leb. Sci. J.*,12(2): 33-44

8-Fakhri, M., Romano, J.-C., Abboud - Abi Saab, M., 2011. Impact of wind on the dispersion of contaminants in the Lebanese northern marine area. *Journal of the Black Sea / Mediterranean Environment*., 17(1), 32-46