

The National Institute of Chemistry Slovenia is seeking to develop a joint funding proposal with experienced (post) PhD researchers for submission under the Marie Skłodowska Curie Individual Fellowship (MSCA IF). The National Institute of Chemistry, which employs over 250 researchers, has applied 35 patents in last 5 years and is running 13 Horizon 2020 funded projects, is positioned in the center of Ljubljana, the capital of Slovenia, a small country nestled between the Alps and the Mediterranean.

More information about the institute is available at [www.ki.si](http://www.ki.si)



NATIONAL INSTITUTE OF CHEMISTRY, LJUBLJANA, SLOVENIA



#### MARIE SKŁODOWSKA CURIE INDIVIDUAL FELLOWSHIP CALL UNDER HORIZON 2020

The applicants must be at the time of proposal submission, which is **12th of September 2018**, in possession of a doctoral degree or at least four years of research experience (full-time equivalent).

Anyone interested in the themes outlined below is kindly invited to submit an Expression of interest (CV and short description of research area) to an e-mail address:

[project.office@ki.si](mailto:project.office@ki.si) .



## Proposed research topics:

### *1. Designed bionanostructures (protein origami)*

Supervisor: prof. Dr. Roman Jerala

### *2. Cancer immunotherapy*

Supervisor: prof. Dr. Roman Jerala

### *3. Synthetic biology of mammalian cells – design of signaling pathways*

Supervisor: prof. Dr. Roman Jerala

### *4. Visible light assisted photocatalysis for water treatment*

Materials used as photocatalysts in the process of heterogeneous photocatalytic oxidation must be significantly improved in order to make this process economically attractive. In this respect, novel nanostructured and nanoshaped photocatalysts (including nanoplasmonic solids) will be developed that will allow efficient harvesting of visible light spectrum. The developed materials should have appropriate morphological, optical and electronic properties which will minimize charge recombination, and on the other hand maximize oxidative destruction and mineralization of water dissolved organic pollutants.

Supervisor: prof. Dr. Albin Pintar

### *5. Direct biogas to liquid fuel conversion*

Biogas (i.e. a mixture of methane and carbon dioxide) is produced by anaerobic dark fermentation of solid waste and renewables. However, to ease its utilization it would be from the practical point of view of great significance to transform biogas to liquid fuels or liquid fuel additives, without the formation of intermediate synthesis gas. In this respect, multifunctional heterogeneous catalysts will be developed that will enable efficient and direct transformation of biogas to either dimethylether or methanol in a single reactor unit.

Supervisor: prof. Dr. Albin Pintar

### *6. Catalytic Carbon Dioxide Activation and Conversion by Hydrogenation or Alkylation*

- developing the concept of the “Methanol Economy” on the chemical recycling of CO<sub>2</sub> to useful fuels
- utilizing the parallel reactor system with heated gas sampling system (w/ recycle option), automation to enable the computer control, data logging and automatic conduction of experiments
- identifying the nature and role of each metal component in catalyst over CO<sub>2</sub> hydrogenation
- emerging of low temperature reactions which can achieve a 100 % selectivity to methanol, so that it can reduce the consumption of energy on the reactor and reduce production costs
- expanding and investigating the predominant reaction pathway to further mixed metal oxide catalysts

Supervisor: prof. Dr. Blaž Likozar

### *7. Direct Catalytic Methane Activation and Conversion to Aromatics and Alkenes*

- Methane utilization – one of the most important research targets in catalysis
- Methane-to-propylene and methane-to-aromatics processes
- Catalysts – CeO<sub>2</sub> nanocrystals, zeolites & others
- Development of novel catalytic routes
- Propylene – raw material for a wide variety of products

Supervisor: prof. Dr. Blaž Likozar

### *8. Catalytic Cellulose, Hemicellulose and Lignin Conversion to Value-added Bio-based Chemicals*

- Advance technology development for bio-refining & biotechnological process exploitation of different (LC/marine) biomasses

- Cellulose fraction conversion to sorbitol, adipic acid or levulinic acid
- Hemicellulose-derived furfural upgrade towards bio-monomers
- Micro-kinetic model development for lignin depolymerisation reactions
- Gas solubility studies in complex biomass-derived compounds using high-pressure view cell

Supervisor: Dr. Miha Grilc

#### *9. Electrocatalytic Carbon Dioxide Activation and Reduction, Electrolysis and Fuel Cells*

- Miniaturized PEM FC system (membrane electrode assembly (MEA) of c. 1 cm<sup>2</sup>)
- In-depth microscopy durability studies and method development
- New electrochemical processes for platinum-group metals (PGM) recycling
- In-situ electrochemical transmission electron microscopy (TEM)
- CO<sub>2</sub> reduction in water and organic solvents (CO, methanol and ethylene)

Supervisor: Dr. Nejc Hodnik

#### *10. Pharmaceutical Process Engineering and Design for Small Molecules and Biosimilars*

- Translation of mechanistic multi-scale modelling to various unit operations and active pharmaceutical ingredients (API)
- Continuous process design and optimization (predominantly for crystallizations and different chromatographic processes)
- Miniaturization (i.e. plant-on-a-chip) and parallelization (i.e. numbering-up instead of conventional scale-up)
- Disposable and single-use equipment application, as well as its optimization, where benefits would arise
- Development of in-house software packages by compiling the existing mechanistic process modelling codes

Supervisor: Dr. Uroš Novak

#### *11. Synthesis and advanced electrochemical characterisation of low-cost and sustainable electrocatalysts for Fuel Cells/Electrolysers*

Supervisor: prof. Dr. Miran Gaberšček

#### *12. Possible topics for joint research are also in connection with keywords below:*

Spectrally selective paint coatings, high solar absorptivity coatings, cool coatings, flame retardants, electrochromic devices, dye synthesized solar cells, thermochromic coatings, ionic liquids, anticorrosion coatings, pigments surface modification, hydrophobic surfaces, oleophobic surfaces, electrolytes, antifouling coatings, self-healing coatings

Supervisor: prof. Dr. Ivan Jerman

#### *13. Structural and functional studies of proteins involved in pathogenesis of intracellular bacteria (e.g. Listeria monocytogenes)*

Supervisor: prof. Dr. Gregor Anderluh and Dr. Marjetka Podobnik

#### *14. Membrane interactions and mechanism of action of pore forming toxins from all kingdoms of life*

Supervisor: prof. Dr. Gregor Anderluh and Dr. Marjetka Podobnik

#### *15. Studies of interactions between proteins and membranes at the structural and functional level*

Supervisor: prof. Dr. Gregor Anderluh and Dr. Marjetka Podobnik

#### *16. Evolution of small tightly folded binding modules and ligand binding sites*

Supervisor: prof. Dr. Gregor Anderluh and Dr. Marjetka Podobnik

#### *17. Synthetic biology of nanopores*

Supervisor: prof. Dr. Gregor Anderluh and Dr. Marjetka Podobnik

*18. Structural and functional studies of plant viruses*

Supervisor: prof. Dr. Gregor Anderluh and Dr. Marjetka Podobnik

*19. Development and application of solid-state NMR methods for the investigations of formation, for structure determination and for in-situ studies of the performance of porous catalysts and adsorbents*

Expertise required by the applicant: basic programming skills (e.g. C, Matlab or similar), familiarity with Linux is an advantage.

Supervisor: prof. dr. Gregor Mali

*20. Development of nanoporous materials for heat storage/transformation applications, including design of new porous solids and post-synthesis modification of sorbents*

Tailoring of hydrophilic properties of inorganic and metal-organic sorption materials. Expertise required by the applicant: Laboratory synthesis skills, understanding/use of characterisation methods (XRD, TG/DSC, SEM, gas sorption).

Supervisor: prof. Dr. Nataša Zabukovec Logar and Dr. Alenka Ristić

*21. Development of nanoporous materials for carbon capture and utilization (CCSU) technologies*

Providing more compact configurations (composite materials, porous monoliths, etc.) to improve the energy and production costs in gas separation and conversion. Expertise required by the applicant: Laboratory synthesis skills, Understanding/use of characterisation methods (XRD, TG/DSC, SEM, gas sorption)

Supervisor: prof. Dr. Nataša Zabukovec Logar and Dr. Matjaž Mazaj

*22. Development of multimetal functionalized porous materials for catalytic air and water purification*

Metals on porous supports, metals on mixed oxides photocatalyst  $\text{TiO}_2/\text{SiO}_2$ , double layered hydroxides on porous supports. Expertise required by the applicant: Laboratory synthesis skills, understanding/use of characterisation methods (XRD, TG/DSC, SEM, gas sorption).

Supervisor: prof. Dr. Nataša Novak Tušar

*23. Artificial SEI on metal lithium*

Li-ion batteries are most promising portable storage devices and their energy density can be further improved by replacement of negative electrode by metallic lithium. If we want to avoid formation of dendrites and constant passivation the latter needs to be protected. Protection layers can be based on polymers or alloys.

Supervisor: prof. Dr. Robert Dominko

*24. The role of protein dynamics at the ligand-protein binding process*

The aim of these studies is a site specific characterization of protein dynamic processes in ligand-protein complexes on a wide range time scale at atomic level using spectroscopic methods and molecular dynamics simulations. This is required for the proper understanding of ligand-protein binding mechanisms. In general, the anticipated results will inspire future research of the poorly explored role of dynamics and molecular flexibility in biological processes and can have direct impact on the development of novel therapeutic agents.

Supervisor: prof. Dr. Simona Golič Grdadolnik

*25. Protein aggregation monitored by vibrational spectroscopy*

Infrared, micro Raman, VCD, NMR and advanced theoretical methods will be used to study the structural phase transitions of poly-L-lysine and polyglutamate induced by temperature and/or by changing the pH. The stability of peptide structure and intermediates will be tested in the presence of various types of cosolvents. Acquired knowledge from model systems will be applied in the study of amyloidal aggregation of insulin, which is related to type I diabetes mellitu.

Supervisor: prof. Dr. Jože Grdadolnik

*26. Computational characterization of structural dynamics underlying function in proteins*

Molecular dynamics simulations and free energy calculations are powerful biophysical tools offering spatial and temporal resolutions that can effectively complement experimental methodologies in studying molecular basis of protein function:

- How hydration water assists protein function?
- How does water pass through membrane transporters (SGLT)?

Supervisor: prof. Dr. Franci Merzel

**More info about the call:**

<http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-msca-if-2018.html>

MSCA IF is a proposal applying for the financial mechanisms of the European Commission. The application must be developed jointly by the researcher and the supervisor. The cost covered for the period of working for MSCA IF project are around 4000, 00 € for living allowance, 600, 00 € for mobility allowance and 500, 00 € for family allowance per month.

**NOTE:** If you apply with National Institute of Chemistry, Slovenia, you are eligible for the WIDENING panel. Beside that Slovenia has established the complementary funding scheme for execution of MSCA IF proposals gaining the Seal of Excellence (if reaching score of over 85 %).