

Job offer – PhD in Production of Sustainable Aviation Fuel Components
(For non-French scientists only)

Research Project Short Title as Submitted to CEFIPRA: “BIOJET-X, BIOMass to JET fuel with eXtra-large-pore zeolites”
Principal Investigator contact (Name and email id): “Ludovic Pinard, Laboratoire Catalyse et Spectrochimie (LCS), ENSICAEN, Caen, ludovic.pinard@ensicaen.fr”
Reference Number of the Job Offer: IFI_CEF_26_16

Project description

- **Keywords :** Sustainable aviation fuels; Furfural upgrading; Extra-large-pore zeolites; Bifunctional catalysis; Operando spectroscopy; Catalyst deactivation
- **Context :** The development of sustainable aviation fuels calls for catalytic routes that convert lignocellulosic feedstocks into hydrocarbons in the jet-fuel range. Furfural is a versatile biomass-derived platform molecule, but its upgrading involves bulky intermediates that can limit access to active sites and promote catalyst deactivation. BIOJET-X investigates extra-large-pore zeolites, particularly ZEO-1 and ZMQ-1, to address these challenges. Combining tailored acidity with earth-abundant metal functions, the project aims to control carbon-carbon coupling, oxygen removal and product distribution. The doctoral research brings together catalyst design, reaction engineering and operando spectroscopy within a complementary collaboration between LCS in France and RGIPT in India.
- **Abstract of the Research Project :** BIOJET-X aims to develop multifunctional catalysts for converting furfural and 2-methylfuran into jet-range hydrocarbons through hydroxyalkylation-alkylation (HAA), followed by hydrodeoxygenation (HDO). The central hypothesis is that the accessible pore systems of ZEO-1 and ZMQ-1 can facilitate the transport of bulky furanic intermediates and help limit deactivation, while metal-acid cooperation enables selective conversion.
Based at LCS, the PhD candidate will synthesize and functionalize extra-large-pore zeolites, establish their physicochemical properties, and investigate catalytic activity, selectivity and regeneration in batch reactors. Metal-containing formulations will be compared with conventional HZSM-5 and Y zeolite benchmarks. Particular emphasis will be placed on identifying reaction intermediates and deactivation pathways using operando infrared spectroscopy and complementary characterization.
The doctoral work will contribute primarily to WP1 and WP2. In parallel, RGIPT will produce biomass-derived furfural and evaluate selected catalysts in continuous-flow reactors (WP3 and WP4). Joint interpretation will link catalyst structure and active-site properties to performance with model and biomass-derived feeds. Expected outcomes include catalyst design guidelines and promising formulations for producing renewable jet-fuel components.
- **Scientific Objectives of the Project :**
 1. Design bifunctional catalysts based on ZEO-1 and ZMQ-1, with tailored acidity and selected earth-abundant metal functions, using HZSM-5 and Y as reference supports.
 2. Optimize HAA coupling towards C15 precursors and subsequent HDO towards C9-C15 hydrocarbons, assessing conversion, selectivity and carbon balances.
 3. Establish relationships between pore accessibility, acid and metal sites, reaction pathways and deactivation, with particular attention to coke and humin formation.
 4. Identify two lead catalysts, develop regeneration strategies and provide mechanistic and performance data to support continuous-process validation with the Indian partner.
 6. Integrate the developed bearings into an industrial compressor configuration and demonstrate their feasibility through in-situ testing, targeting TRL 5.
- **Methodology and Timeline of the Project .:** *Indicative doctoral timeline; months are counted from the start of the PhD.*

1. **Months 1-9 - Synthesis and characterization.** Prepare ZEO-1 and ZMQ-1 and introduce selected metals by impregnation, ion exchange or deposition-precipitation. Start benchmark experiments early. Characterize structure, porosity, composition, acidity and metal dispersion using XRD, gas physisorption, ICP, electron microscopy, solid-state NMR and probe-molecule FTIR, with the support of specialist platforms.
2. **Months 4-18 - Catalytic testing and operando studies.** Investigate model furfural/2-methylfuran feeds in batch reactors: HAA at 120-180 °C and HDO at 300-400 °C under 20-40 bar H₂. Quantify products, selectivity and carbon balances. Progressively validate liquid-phase, high-pressure operando FTIR experiments to investigate adsorbed intermediates and coke precursors.
3. **Months 12-24 - Stability and catalyst selection.** Correlate catalyst properties with activity and deactivation. Assess spent catalysts and regeneration by oxidative or reductive treatments, targeting at least five reaction-regeneration cycles per catalyst. Select two lead formulations for transfer to RGIPT.
4. **Months 24-36 - Integration and dissemination.** Compare batch and continuous-flow results with RGIPT, refine structure-performance relationships, and contribute experimental data to durability and process-sustainability assessments. Prepare joint publications, conference presentations and the doctoral thesis.
5. **Key milestones:** a characterized library targeting six extra-large-pore formulations and two benchmarks by month 15; two lead catalysts by month 24; integrated conclusions and thesis preparation by month 36.

Candidate profile

- Candidates can be all nationalities except French. In case of double nationality (French and another one), the candidate is not eligible. In the context of CEFIPRA, Indian candidates are preferred
- Applicants for PhD must have a master's degree (or be in the process of obtaining one) or have a University degree equivalent to a European Master's (5-year duration) to be eligible at the time of the deadline of the call \No competences in French language are required
- Candidate competences: Sound knowledge of heterogeneous catalysis, porous materials or inorganic chemistry. An interest in biomass conversion, reaction mechanisms and catalyst characterization is essential. Experience with zeolites, spectroscopy or catalytic testing is an advantage
- Candidate know-how: Experimental rigor, quantitative data analysis, clear laboratory record-keeping, teamwork and scientific writing. Experience with chromatographic analysis or high-pressure reactors is welcome. Good written and spoken English is required; no knowledge of French is required.
- Expected starting date: 01-04-2027
- Expected duration: 36 months

How to candidate?

Documents to be provided :

- i. A cover letter (reasons for the candidature, professional project ...) max 2 pages
- ii. A copy of the master's degree or a proof of the program followed (and expected date of end) OR A copy of the PhD degree or a proof of the PhD program followed (and expected date of defense) max 1 page
- iii. A copy of results for previous scholarship (max 3 pages)
- iv. International curriculum vitae (max 2 pages)
- v. One letter of recommendation from any Indian institution –mandatory- (max 2 pages)
- vi. All should be submitted within 1 pdf file of no more than 10 pages.
- vii. Applications must be submitted through this **Google Form** selecting the appropriate reference number for the job offer.



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Benefits:

- Monthly allowance of 1870 euros for PhD
- Travel allowance
- University fee
- Carte de séjour fee
- Campus France management fee
- Registration to the French social security scheme

Selection process:

The final selection is made by a dedicated selection committee of scientific experts after a pre-selection phase by the French principal investigator. Decisions will be transmitted by the Embassy of France to CEFIPRA.

Criteria for applicants’ selection:

Academic excellence

- Excellence of the Academic background, Academic records, Honors, Letters of support, Participation to international research projects, exchange programmes and conferences.

Motivation and qualities

- Academic maturity: appropriation of the thesis project (stakes and contexts) • Quality of the presentation (oral expression, skills for synthesis, English level) • Maturity of the professional project: capacity to project her/himself within five years in terms of career development.

About CEFIPRA:

Indo-French Center for the Promotion of Advanced Research (CEFIPRA/IFCPAR) is an Indian body which promotes scientific cooperation between France and India in advanced fields of Science and Technology. It is supported by the Department of Science and Technology, Government of India and the Ministry of Europe and Foreign Affairs of the French government