



## *Ph.D thesis proposal*

# **Lignin as a Biosourced Substrate for Direct Laser Writing of Carbon Electrodes via Laser Induced Graphite (LIG2)**

**Keys words:** Lignin, Laser Induced Graphene (LIG), Electrochemical biosensors, Printed electronics, Composite materials.

**Host Laboratories:** LGP2 and DCM, Grenoble (France). <https://lgp2.grenoble-inp.fr/>, <https://dcm.univ-grenoble-alpes.fr/>

**Summary of the thesis project:** Laser-Induced Graphene (LIG) enables the rapid conversion of organic materials into porous, conductive carbon. Moreover, Laser precision allows the direct patterning of electrodes and circuits onto biobased substrates. Lignin, a wood-derived aromatic polymer, shows strong potential as a sustainable LIG precursor and preliminary tests performed at LGP2/FCBA showed promising results in line with the literature. However, the influence of lignin origin, structure, chemical modification, and processing conditions will interact with LIG. Consequently, despite a very high potential, formation of graphite from lignin remains quite underexplored. This project aims to investigate different lignin sources that will be treated by LIG for obtaining biosourced carbon electrodes. The final objective of the LIG2 project is to demonstrate lignin-derived LIG functionalized with aptamer probes as a platform for low-cost electrochemical biosensors with low carbon imprint.

**Profile and skills required.**

### **Education and Technical Skills**

The candidate must hold a Master's degree (or equivalent) in Materials Chemistry, Polymer Science, Process Engineering, Electrochemistry, or Applied Physics, with a specialization or demonstrated experience in at least one of the following areas:

- Synthesis and characterization of carbon-based materials (e.g., Laser-Induced Graphene, graphene, lignocellulosic composites).
- Laser processing of materials (optimization of irradiation parameters, laser-matter interactions).
- Surface functionalization for biosensing applications (grafting of nucleic acid probes, surface chemistry).
- Electrochemistry and sensors (electrode characterization, conductivity measurements, electrochemical detection techniques).
- Biobased materials (experience with lignin, cellulose, or furanic resins would be a major asset).



Practical experience with the following techniques will be highly valued:

- Physicochemical characterization: SEM, FTIR, Raman spectroscopy, XRD, porosimetry, electrical conductivity measurements.
- Thin film fabrication: coating techniques (casting, spray coating, rod coating), thermal curing.
- Electrochemical analysis tools: cyclic voltammetry, impedance spectroscopy, sensitivity/selectivity measurements.
- Laser processing: use of CO<sub>2</sub> or fiber laser systems, mastery of parameters (power, speed, scan pitch).

#### **Transversal Skills and Personal Qualities**

- Scientific rigor: ability to design and execute complex experimental protocols and analyze multivariate data (e.g., interactions between laser parameters and material properties).
- Autonomy and proactivity: The candidate must be able to collaborate with academic and industrial partners (e.g., FCBA, Politecnico di Torino) while independently driving their project forward.
- Innovative mindset: strong interest in developing sustainable solutions (biobased materials) and applications in printed electronics or environmental/medical diagnostics.
- Writing skills: proficiency in drafting scientific articles and technical reports in English (the project's working language).
- Adaptability: openness to interdisciplinarity (chemistry, physics, biotechnology) and the use of industrial materials (e.g., furfural-derived oligomers, graphite/polymer blends).

**More details and online application on:**

[https://adum.fr/as/ed/voirproposition.pl?site=adumR&matricule\\_prop=70198](https://adum.fr/as/ed/voirproposition.pl?site=adumR&matricule_prop=70198)

**Application deadline:** 18 may 2026