Raman spectroscopy as a predictive tool for Laser-Induced Graphene from wooden biomass

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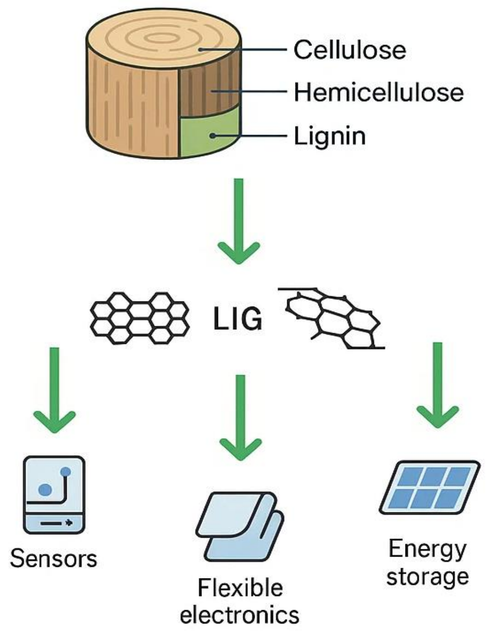
Introduction

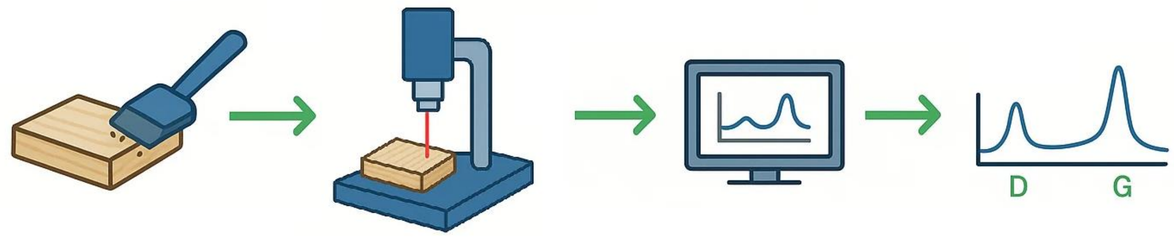
Laser-induced graphene (LIG) is a relatively new method for creating carbon-based materials with unique properties, suitable for applications in electronics, sensors, and optoelectronics. While polymers are widely studied as precursors, wood remains less understood despite its natural abundance. Since the cellulose-to-lignin ratio is known to influence the structure and defect density of LIG, identifying this balance is key for material selection.

This work explores whether Raman spectroscopy can predict LIG quality before laser treatment by analyzing the chemical and structural fingerprints of wood, particularly those linked to cellulose and lignin.



Methodology

- **Material -** spruce wood, in raw offcut form, without chemical pre-treatment,
- **Spectroscopy setup -** 830 nm laser (NIR) to reduce fluorescence background
- **Workflow**:
  1. Surface preparation (removing loose fibers).
  2. Raman measurement in multiple points across the sample.
  3. Baseline correction and smoothing to reveal key peaks.
  4. Analysis of cellulose/lignin ratio and peak shapes (D, G bands).



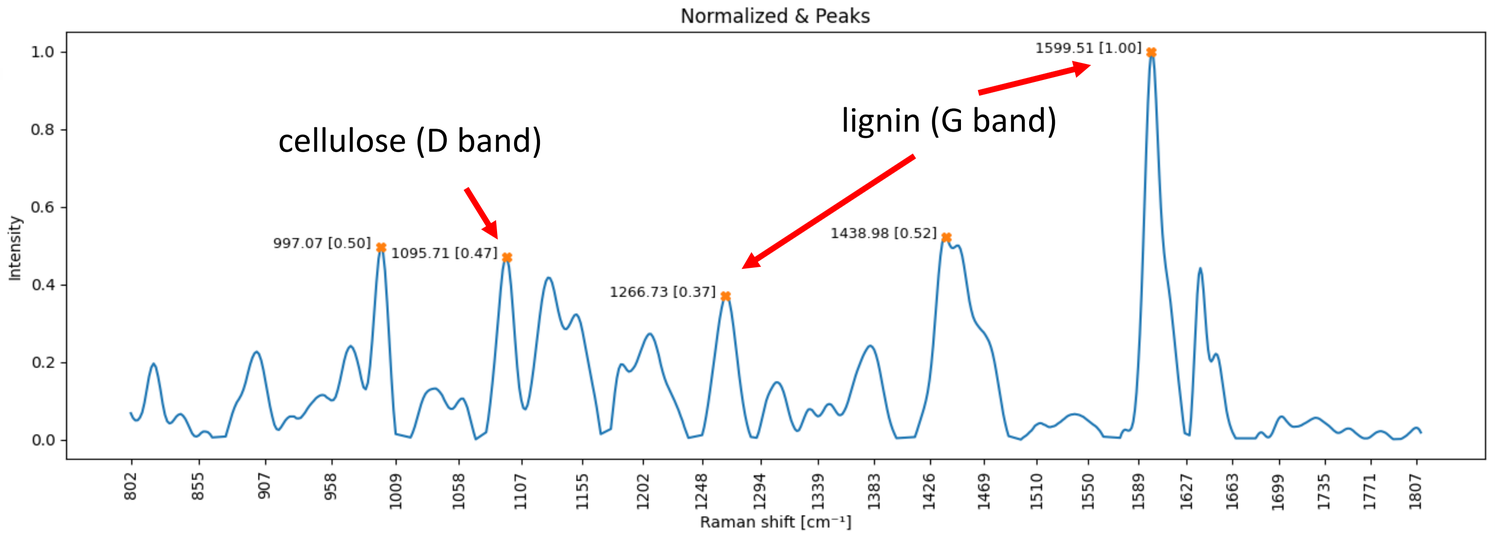
Goal: identify spectral features that correlate with the potential for producing uniform, low-defect LIG.

Results

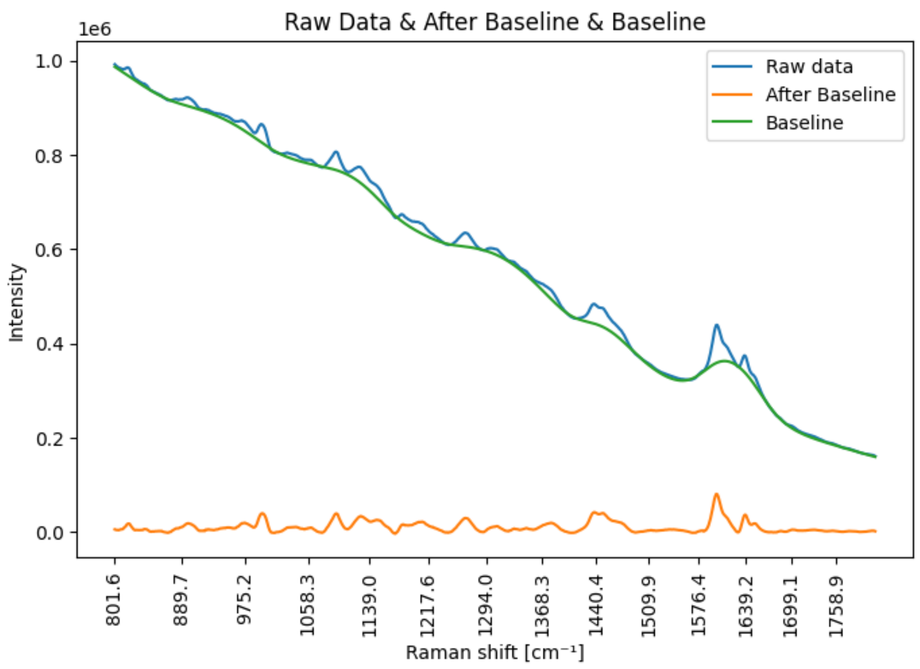
Preliminary Raman spectra of spruce show distinct signatures from cellulose and lignin content.

- Samples with **balanced cellulose/lignin** ratio and well-defined G peaks are likely to yield **uniform, low-defect graphene** after laser treatment.
- Spectral mapping reveals material homogeneity, which is linked to consistent **LIG morphology**.

These early findings suggest Raman can pre-select wooden samples with high carbonization potential.



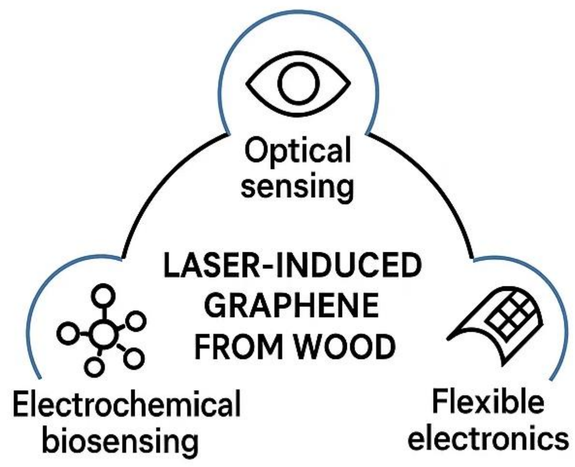
Raman shift [cm^{-1}]	Assign.	Origin
995	**C–O–C stretch**	Cellulose
1100	**C–O stretch**	Cellulose
1265	**Aromatic ring**	Lignin
1600	**C=C stretch (G-band)**	Lignin / Graphitic precursors

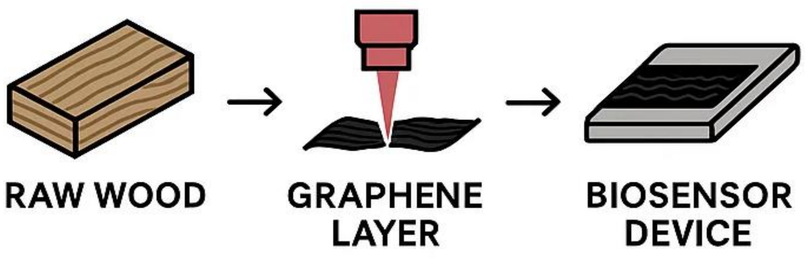


Conclusion

Raman spectroscopy shows strong potential as a **predictive, non-destructive method** for selecting wood types for LIG synthesis.

Advantages:
- **Quick screening** before processing
- Identification of **high-quality** precursors
- Optimization for **optical and electrochemical** biosensing
- **Non-destructive** analysis of samples
- Eco-friendly use of **renewable biomass**
- Cost-effective **reduction** of laser trials





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