

Pulsed laser fabrication technique: a sustainable solution for the production of carbon-based nanomaterials



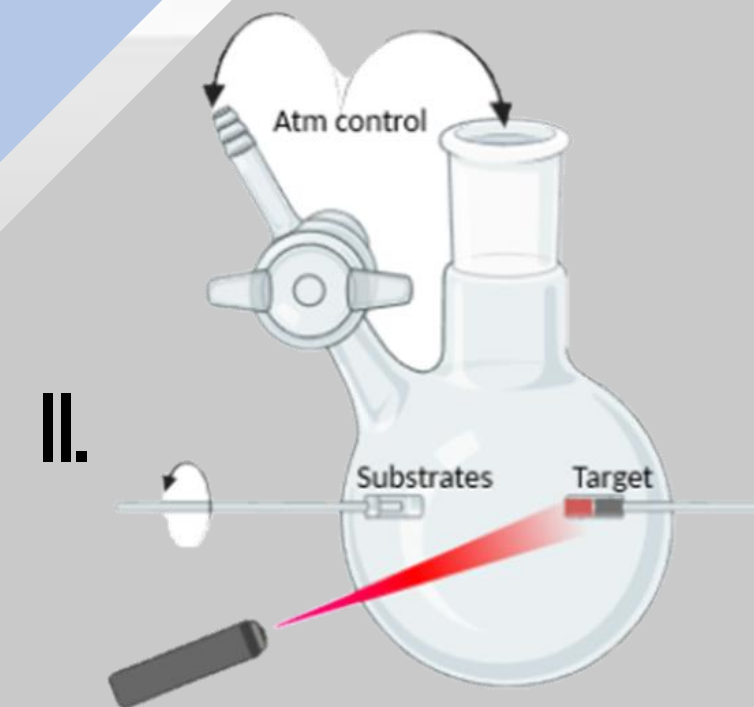
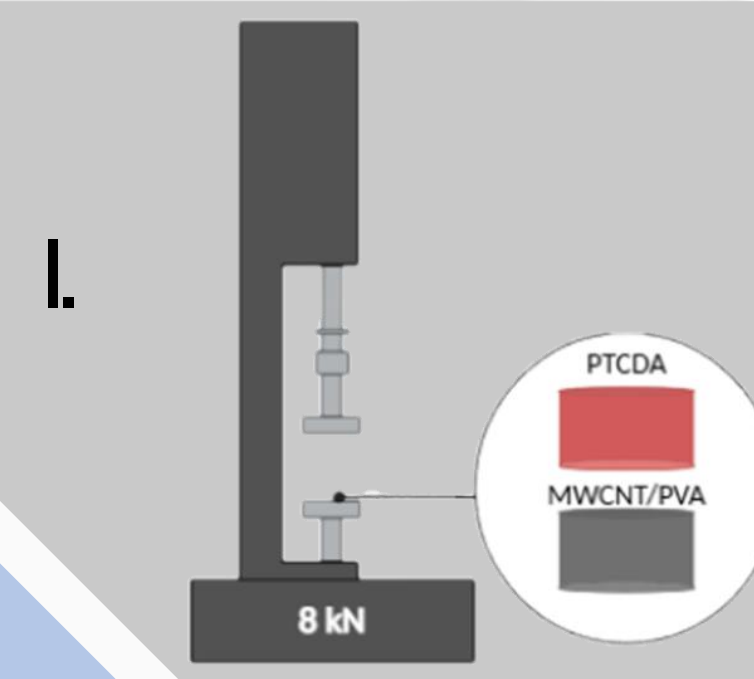
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Background

This study explores a sustainable and cost-effective method¹ for fabricating carbon-based nanostructures using pulsed laser deposition (PLD). Two precursors—PTCDA and MWCNTs mixed with PVA—were used to deposit thin films on various substrates under vacuum, followed by annealing to enhance their properties. The films were characterized using IR, UV-Vis, and SEM-EDX, while electrical properties were assessed via the four-point probe method. Both precursors yielded similar structural results, with MWCNT/PVA films showing improved electrical performance after annealing. The findings highlight PLD as a promising approach for efficient carbon nanostructure synthesis. The subsequent products exhibit significant potential for applications in multiple branches, such as electronics, sensor manufacturing and many other fields².

Methods

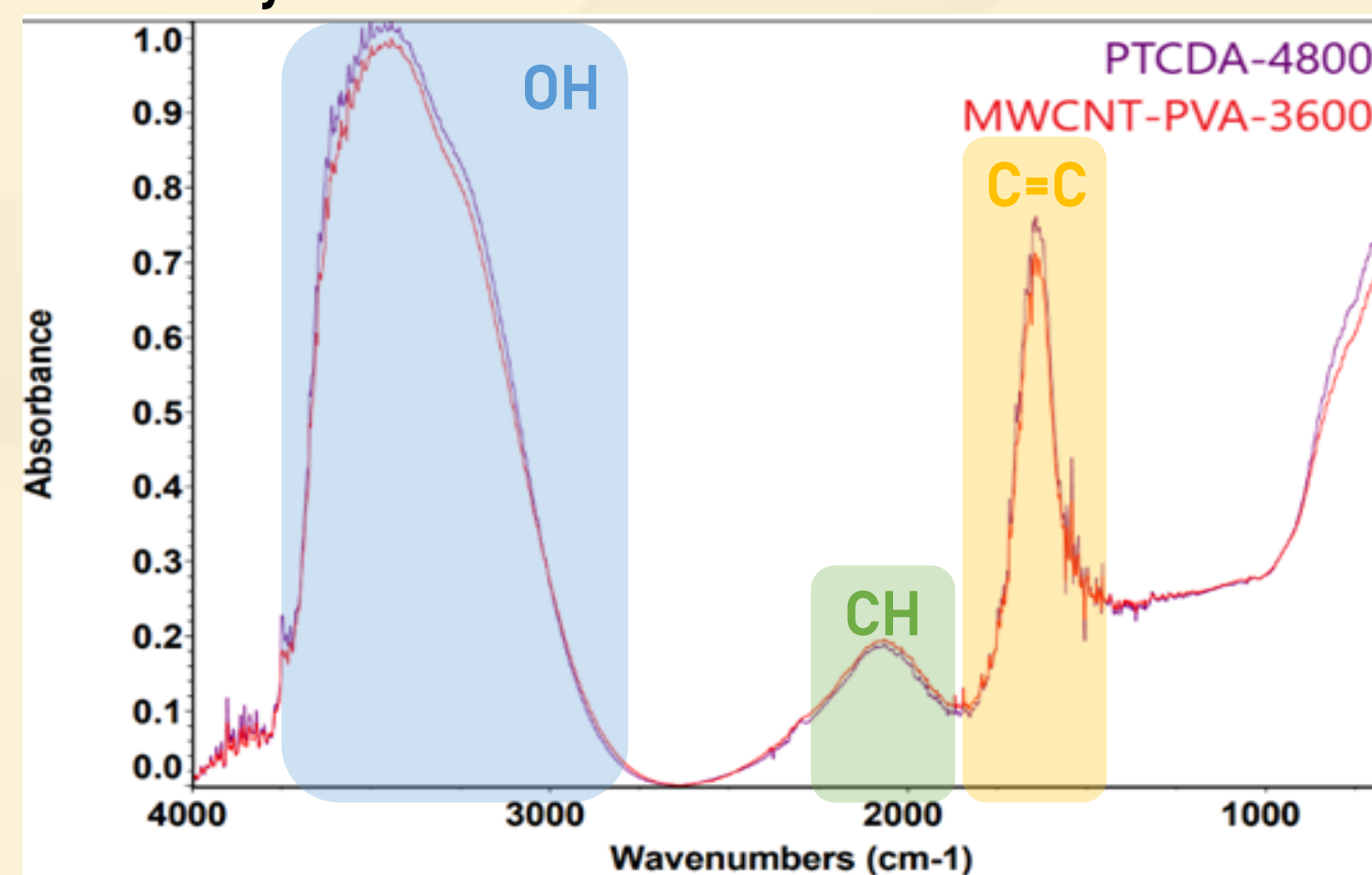


Target	PTCDA/ MWCNT
Substrates	Q, Cu, Corundum
S-T	45 mm
T-F	25 mm
Diaphragm	15 mm
Power	15 J/m ²
Pulses	Δ
Lens	ZnSe
Atmosphere	Evacuated



Results

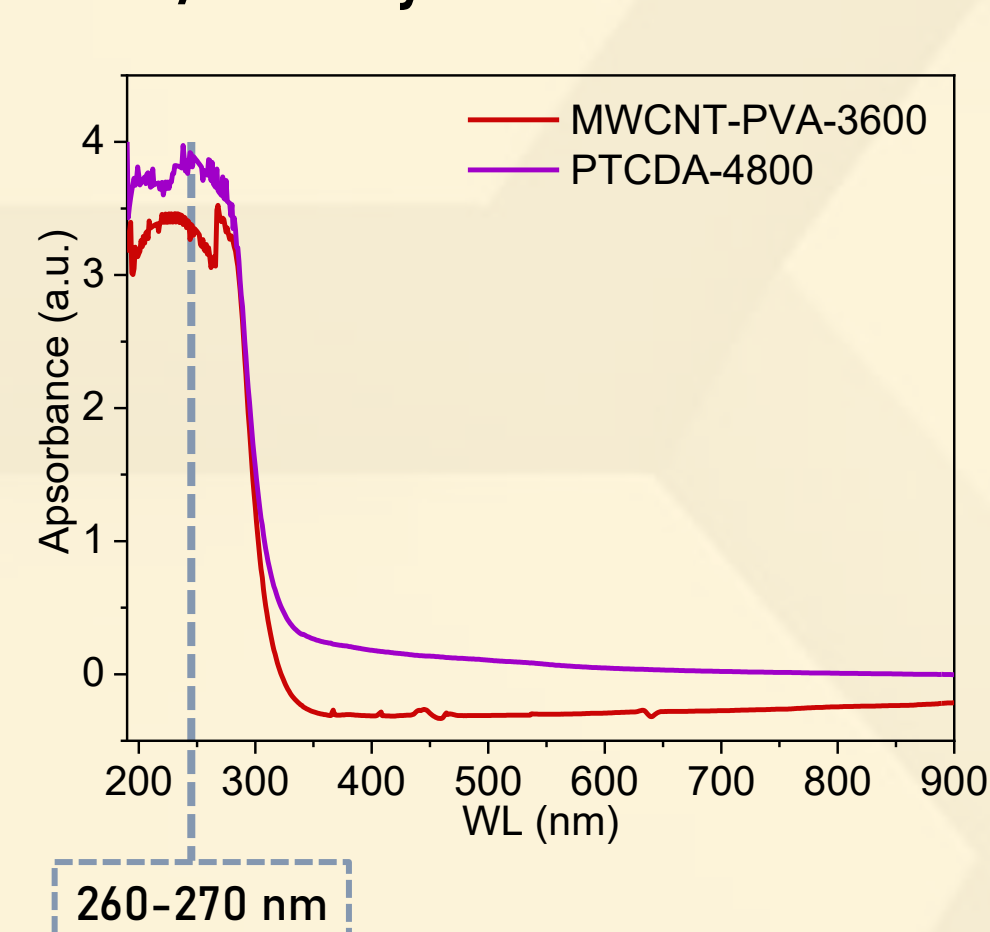
FTIR analysis



	OH/CH	C=C/CH
PTCDA	16.28	1.38
MWCNT	11.90	1.22
Commercial nano-C	32.48	2.47

CH=referent peak

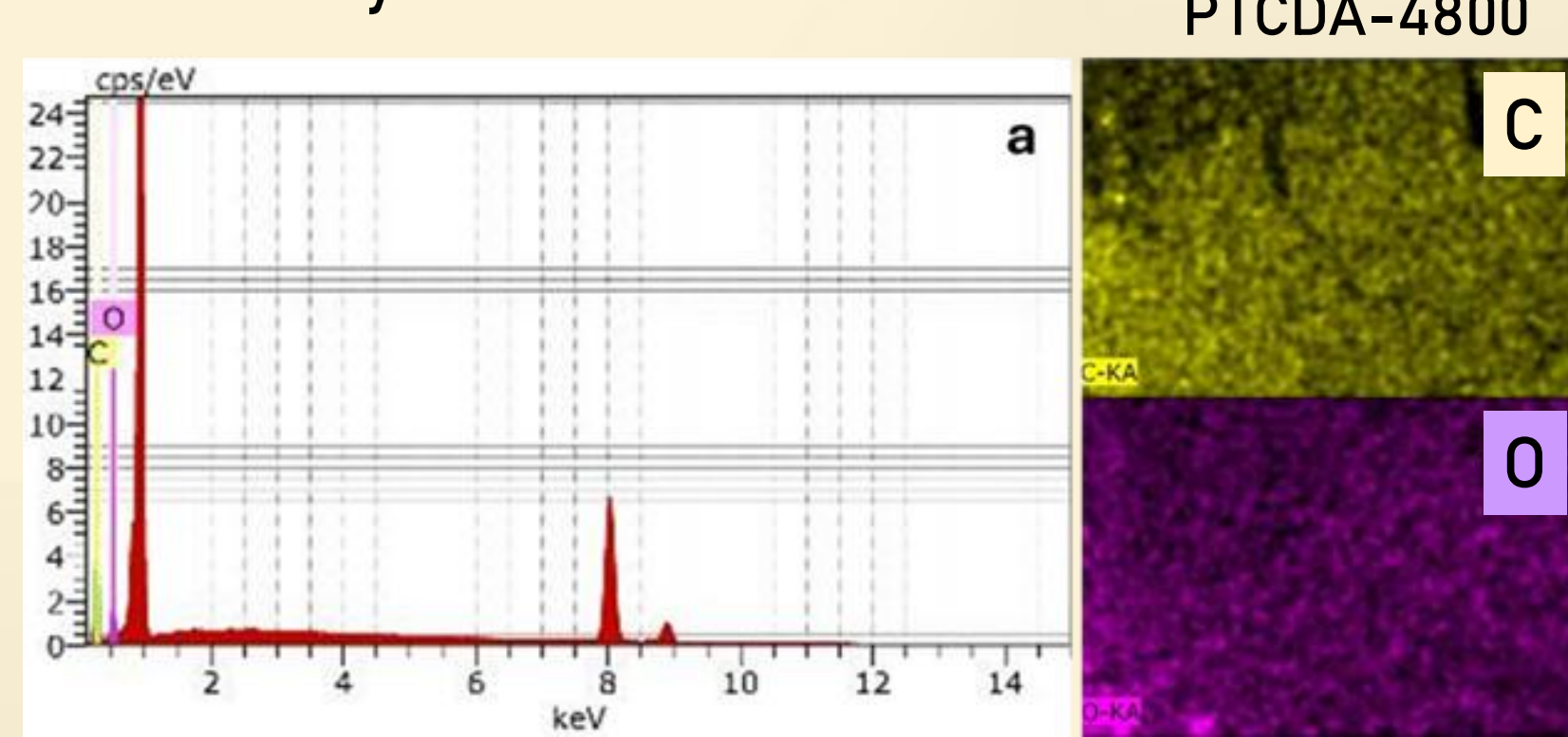
UV/Vis analysis



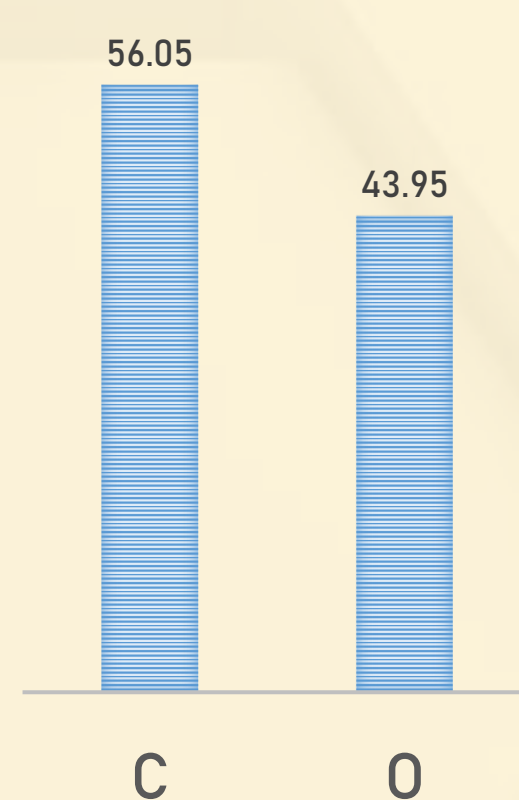
Electrical conductivity analysis [S/m]

	PTCDA	MWCNT
Pure	$1.5 \cdot 10^{-8}$	$4.2 \cdot 10^{-4}$
Before anneal.	$5.1 \cdot 10^{-5}$	$2.5 \cdot 10^{-5}$
After anneal.	$3.9 \cdot 10^{-5}$	$3.5 \cdot 10^{-5}$

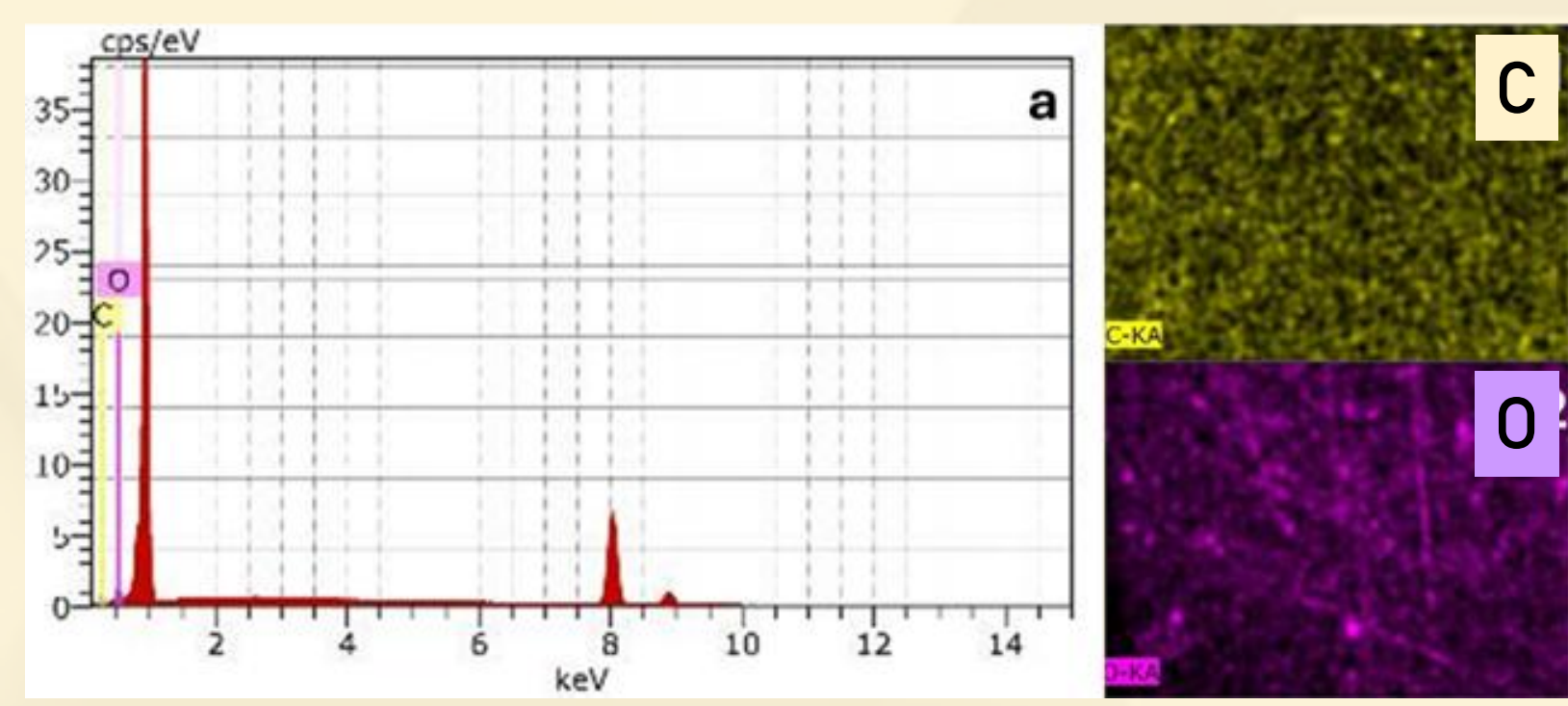
SEM-EDX analysis



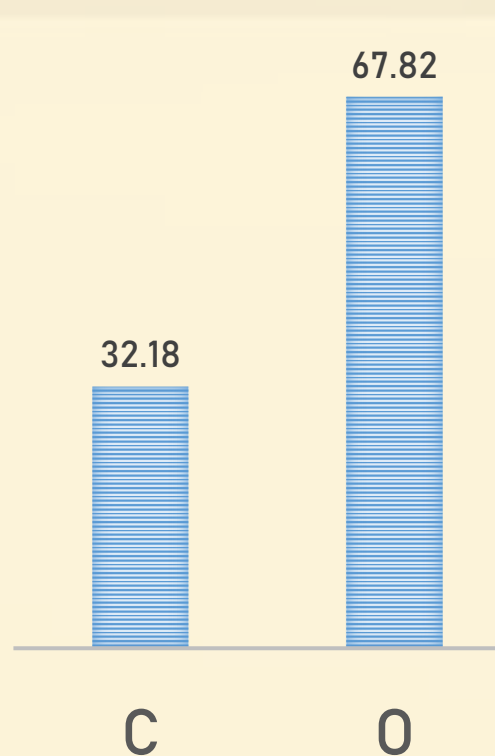
WT%



MWCNT-3600



WT%



Conclusions

- Interestingly, the results suggest that both precursors yield very similar GO products, indicating a comparable reaction pathway or structural outcome.
- FTIR and UV/VIS confirmed functional groups and electronic transitions, while SEM-EDX revealed morphology and composition.
- Improved conductivity (PTCDA) suggests potential for process optimization.
- Pulsed laser deposition is highlighted as an eco-friendly method, avoiding toxic chemicals, lowering energy use, and reducing waste.



References

- Al-Kattan, A., Grojo, D., Drouet, C., Mouskeftaras, A., Delaporte, P., Casanova, A., Robin, J. D., Magdinier, F., Alloncle, P., Constantinescu, C., Motto-Ros, V., & Hermann, J. (2021). Short-Pulse Lasers: A Versatile Tool in Creating Novel Nano-/Micro-Structures and Compositional Analysis for Healthcare and Wellbeing Challenges. *Nanomaterials*, 11(3), 712. <https://doi.org/10.3390/nano11030712>
- Jariwala, D., Sangwan, V. K., Lauhon, L. J., Marks, T. J., & Hersam, M. C. (2013). Carbon nanomaterials for electronics, optoelectronics, photovoltaics, and sensing. *Chem. Soc. Rev.*, 42(7), 2824–2860. <https://doi.org/10.1039/C2CS35335K>