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Synthesis of Nano-Structured Carbon Black from Methane Pyrolysis Using a Transferred Arc Plasma Torch: Structural Characterization and Potential Applications as a Functional Carbon Material

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1 Plasma pyrolysis and carbon recovery

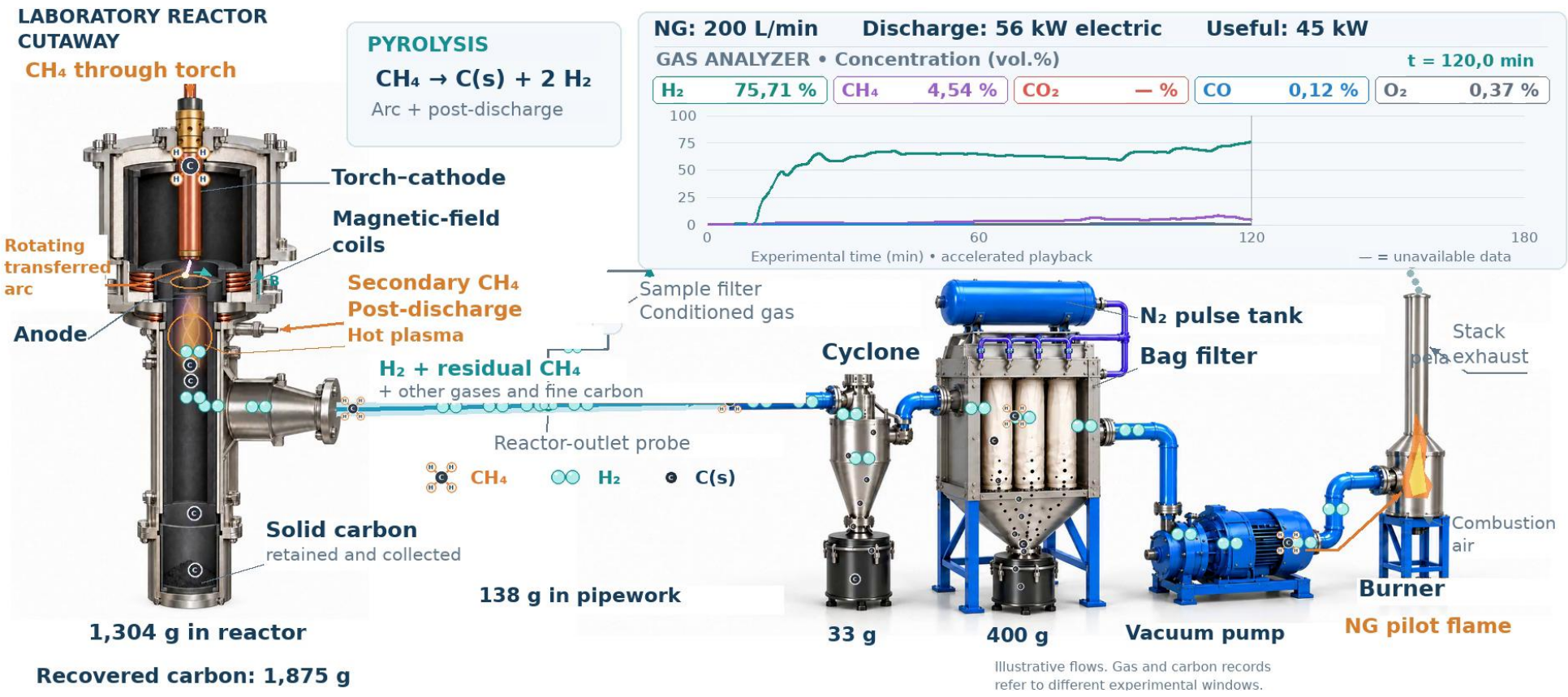


Fig. 1. Laboratory process and gas analysis [1,2]. Initial view: 120 min. Carbon collected: reactor 1,304 g, pipework 138 g, cyclone 33 g and bag filter 400 g.

2 Carbon structure and applications

Natural-gas CB	BET (m²/g)	V_p (cm³/g)
Transferred arc	**189.7**	**0.39**
Non-transferred arc	17.4	0.052

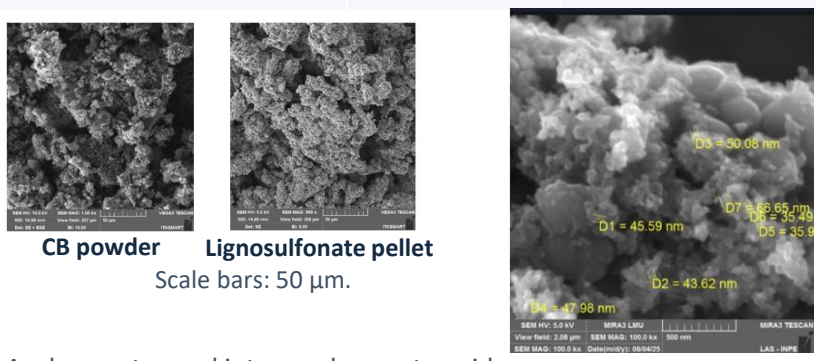


Fig. 2. Agglomerates and inter-agglomerate voids.

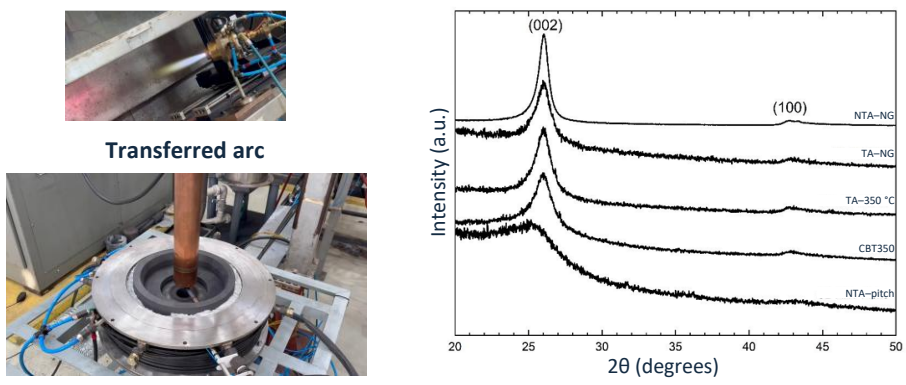


Fig. 3. Broad (002)/(100) peaks show limited graphitic order, consistent with reported Raman D/G bands [3].

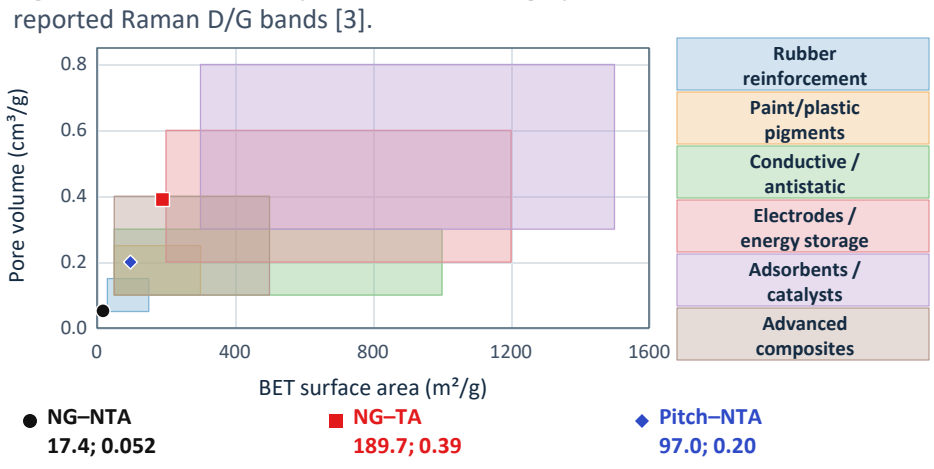


Fig. 4. Indicative application ranges and project samples. Values: BET (m²/g); pore volume (cm³/g). Selection also depends on structure, surface chemistry and formulation.

3 Adsorption and filters



CB/cassava-starch pellets treated at 300, 350 or 400 °C for 2 h.

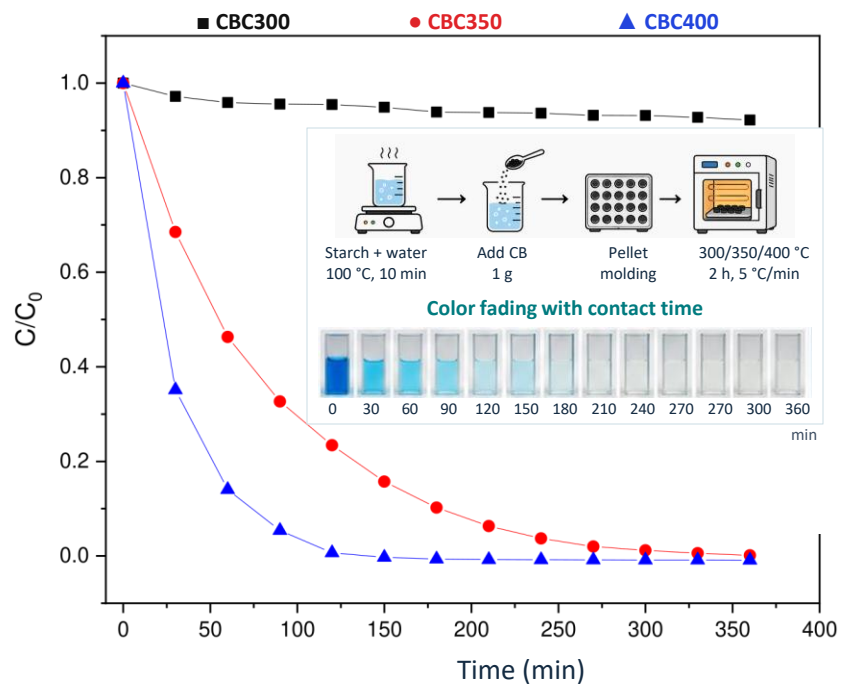


Fig. 5. Preparation and dye adsorption. CBC400 responds fastest. Potential use: adsorbent beds and water-polishing filters.

4 Conductive films



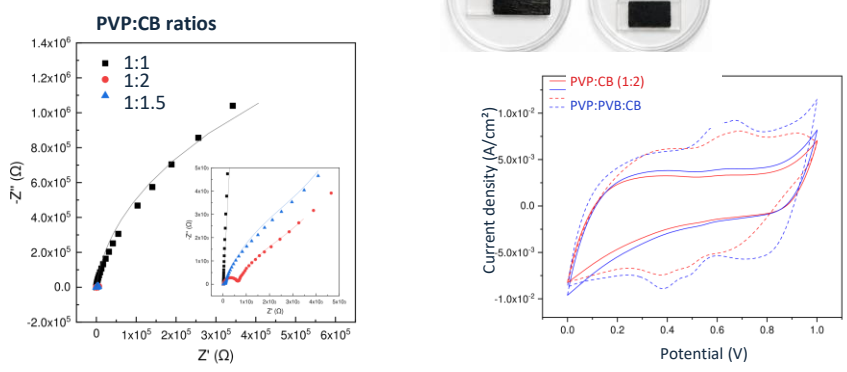


Fig. 6. Higher CB loading lowers impedance. PANI enhances the voltammetric response (solid: without PANI; dashed: with PANI). PVP: polyvinylpyrrolidone. PVB: polyvinyl butyral. PANI: polyaniline. CB: carbon black.

Conclusions

Plasma-derived CB combines high accessible surface, dye adsorption and tunable film response for functional materials.

References [1] FINCKE et al. Ind. Eng. Chem. Res. 41, 1425–1435 (2002). DOI: 10.1021/ie010722e.
[2] FULCHERI et al. Int. J. Hydrogen Energy 48, 2920–2928 (2023). DOI: 10.1016/j.ijhydene.2022.10.144.
[3] FERRARI & ROBERTSON. Phys. Rev. B 61, 14095–14107 (2000). DOI: 10.1103/PhysRevB.61.14095.

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