



Microwave Plasma Reforming of CH_4/CO_2 Mixtures

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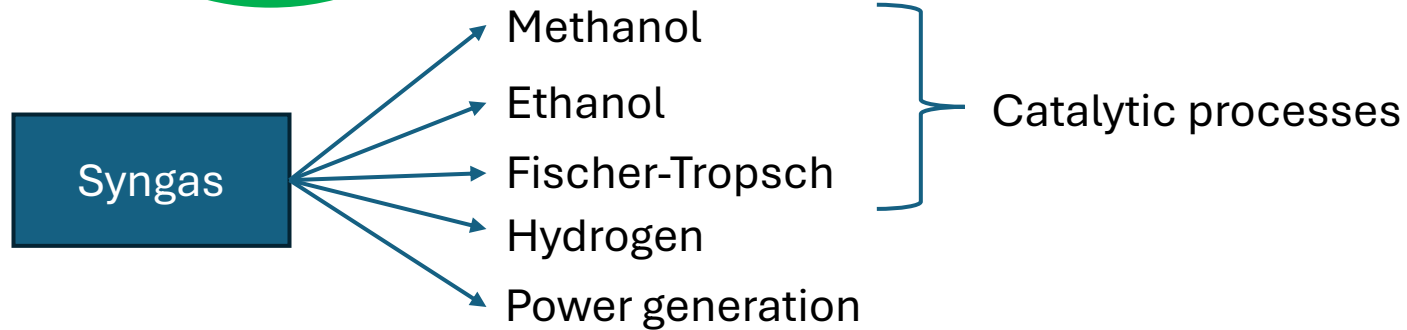
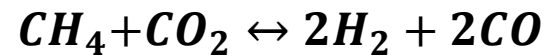
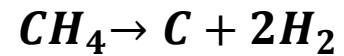
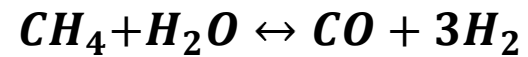
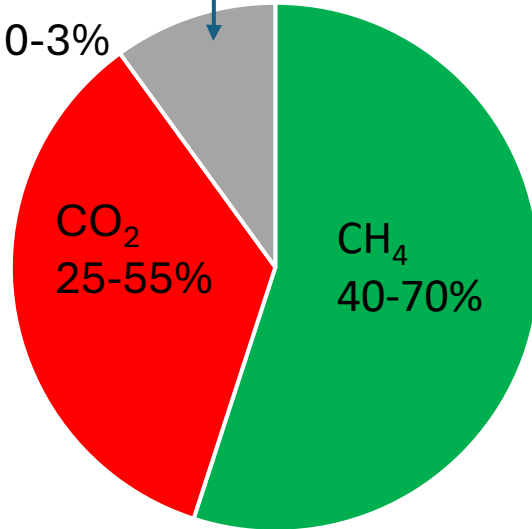
Biogas Reforming

- Rapid population growth.
- Ever-increasing energy demand.
- Escalating waste generation.
- Greenhouse gas emissions and accelerating climate change.
- **Utilization of waste and greenhouse gases to produce valuable products.**

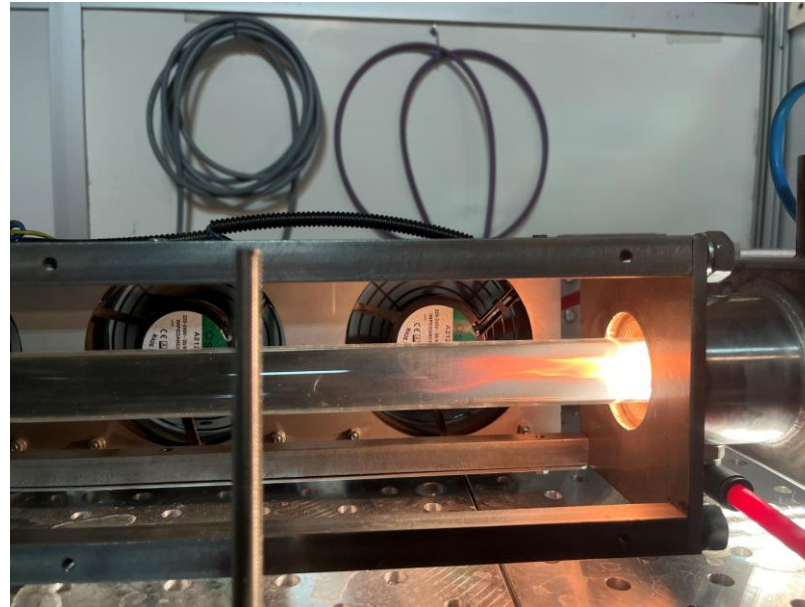
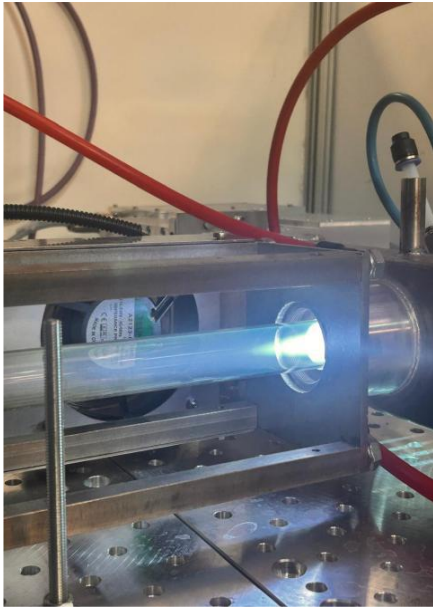


Biogas Reforming

N_2 : 0-5%
 H_2 : 0-1%
 H_2S : 0-3%



Microwave (MW) plasma dry reforming of methane (DRM) – process conditions



Flow rate:
20, 30, 40 SLM

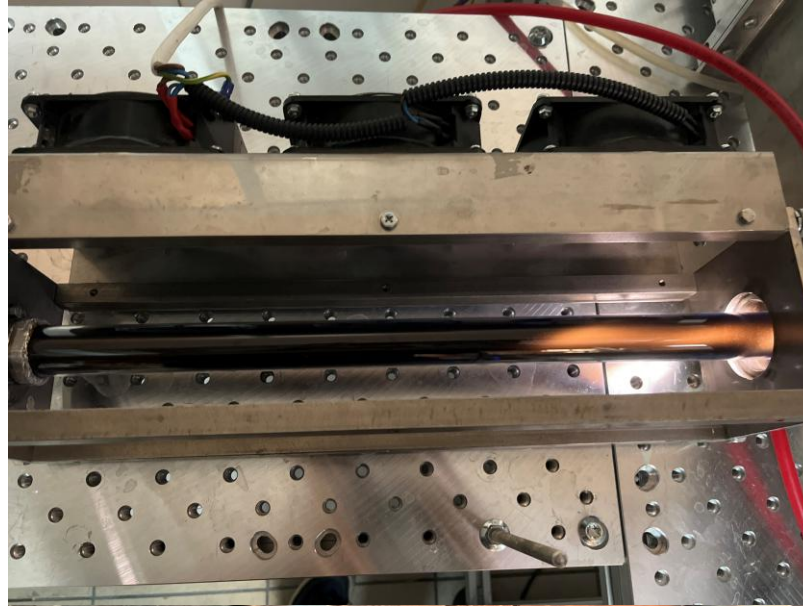
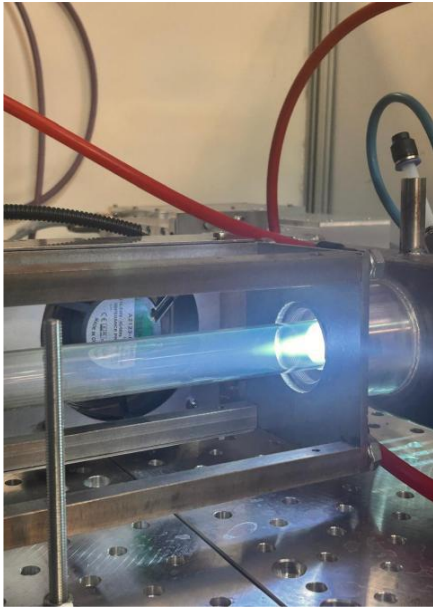
Input MW power:
1800-3000 W

$\text{CO}_2:\text{CH}_4$ ratio

3:1

0:1

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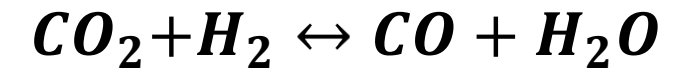
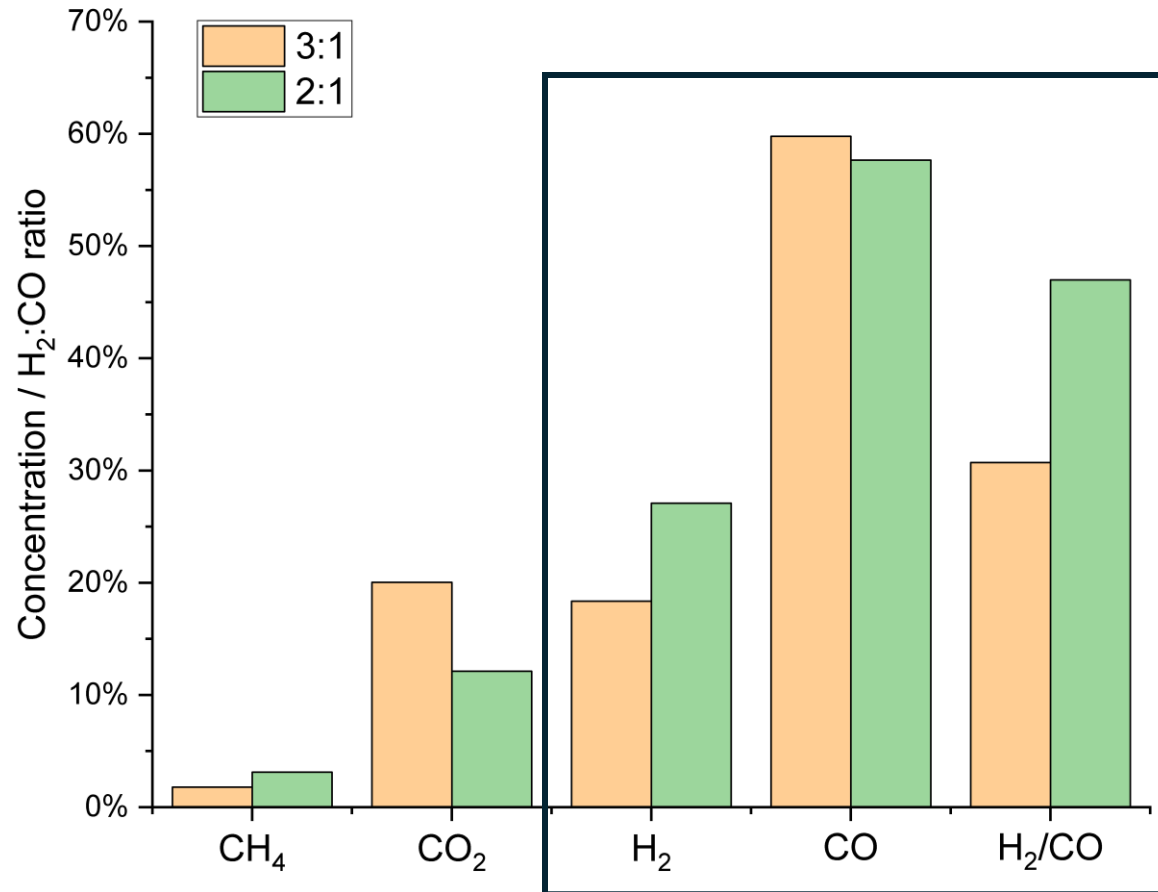
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MW plasma DRM – results

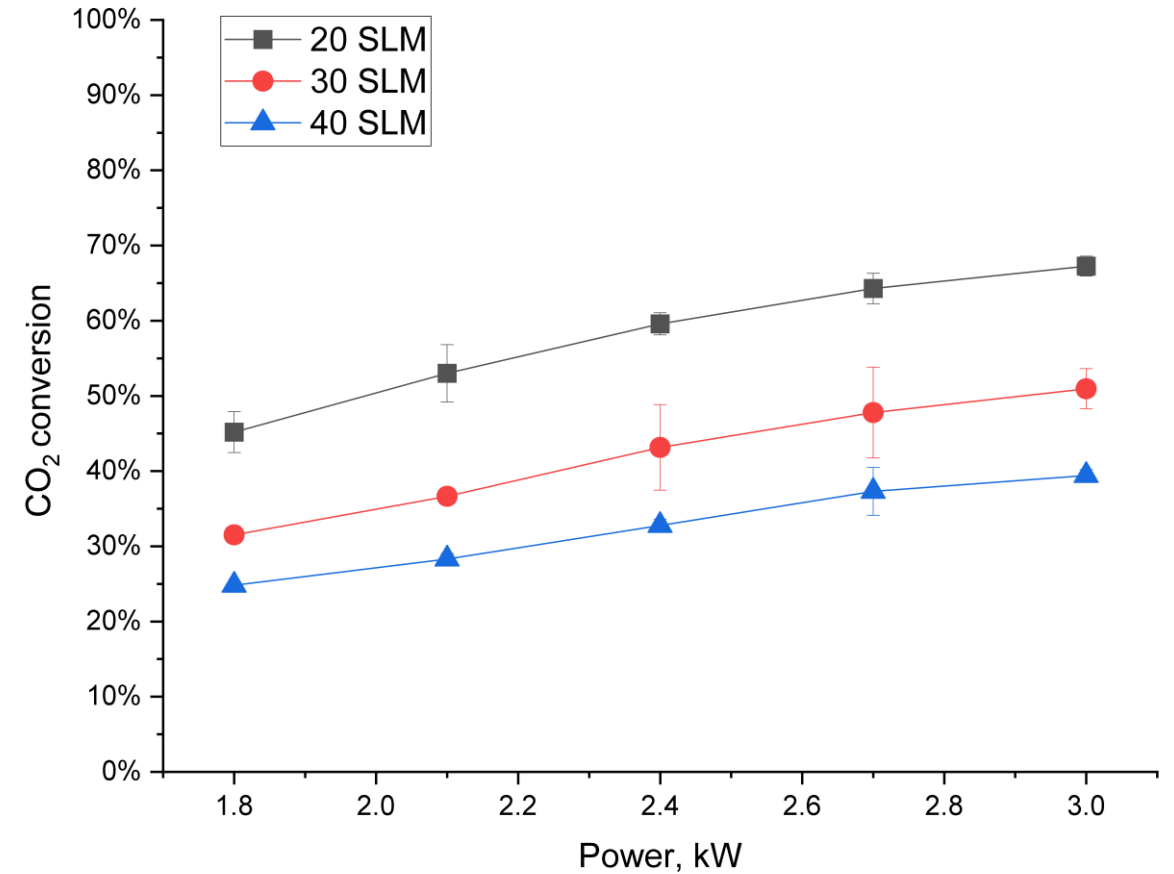
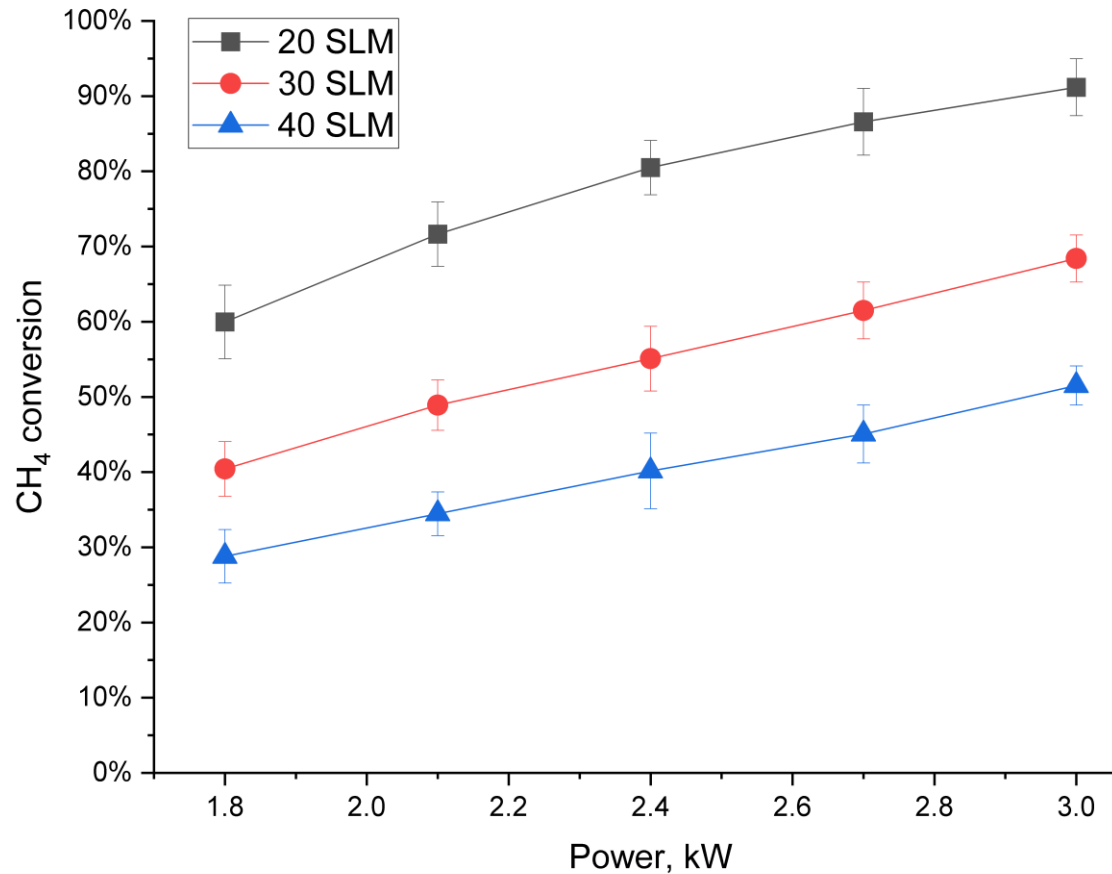
Products concentration



Reverse Water-Gas Shift
reaction (RWGS)

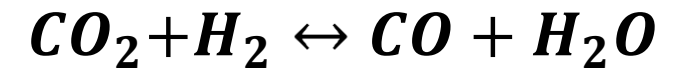
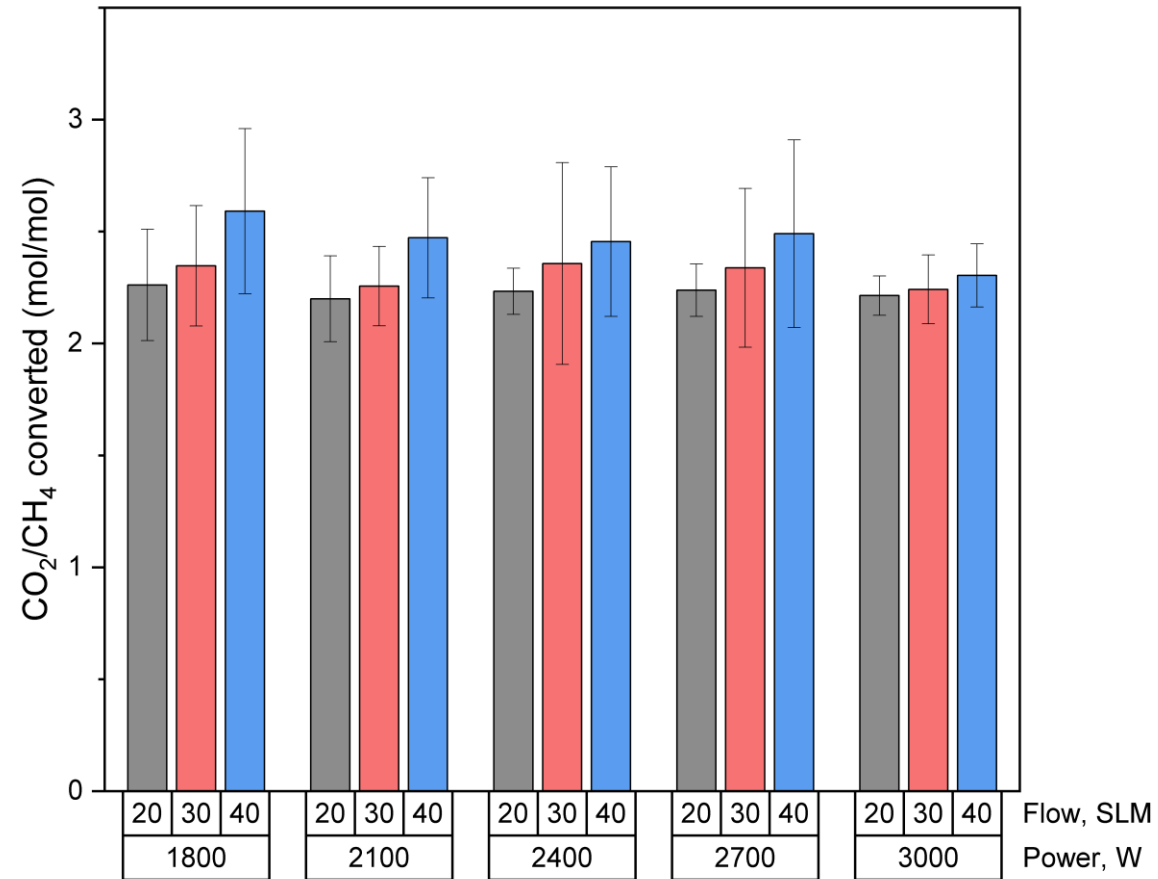
MW plasma DRM – results

Conversion



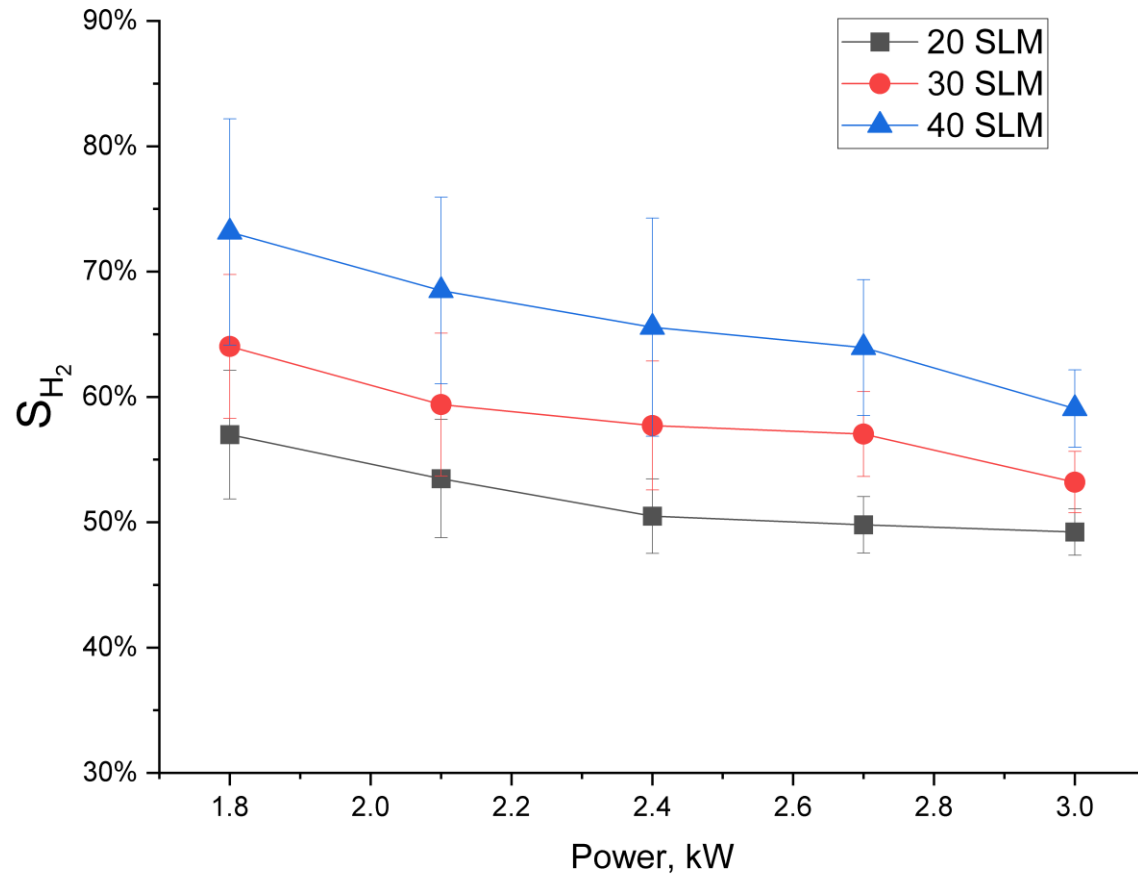
MW plasma DRM – results

Conversion



MW plasma DRM – results

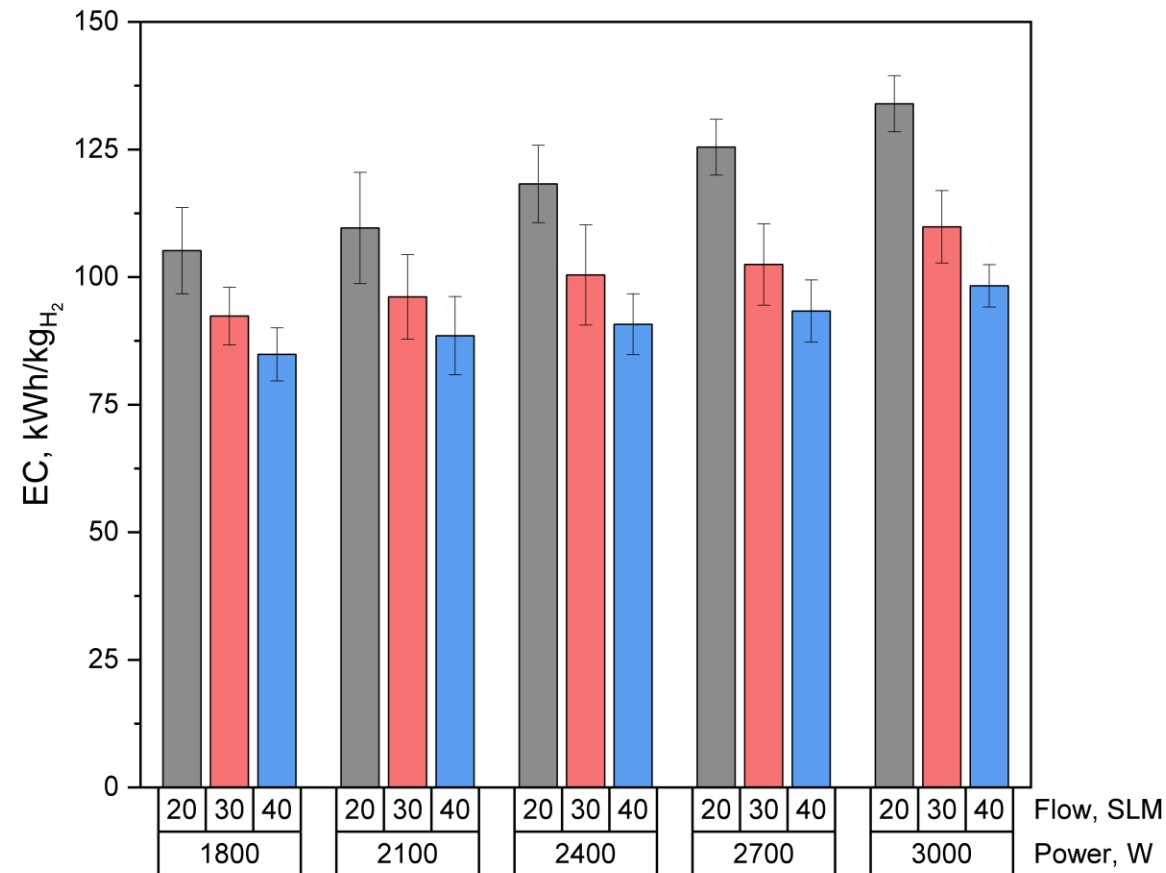
Selectivity



- CO selectivity is 99-100%
- The rest of H-based selectivity is mostly towards water

MW plasma DRM – results

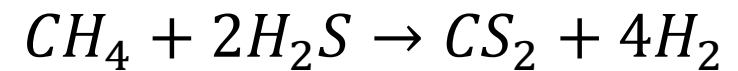
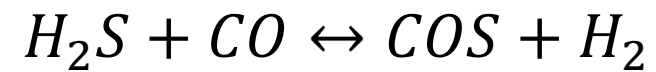
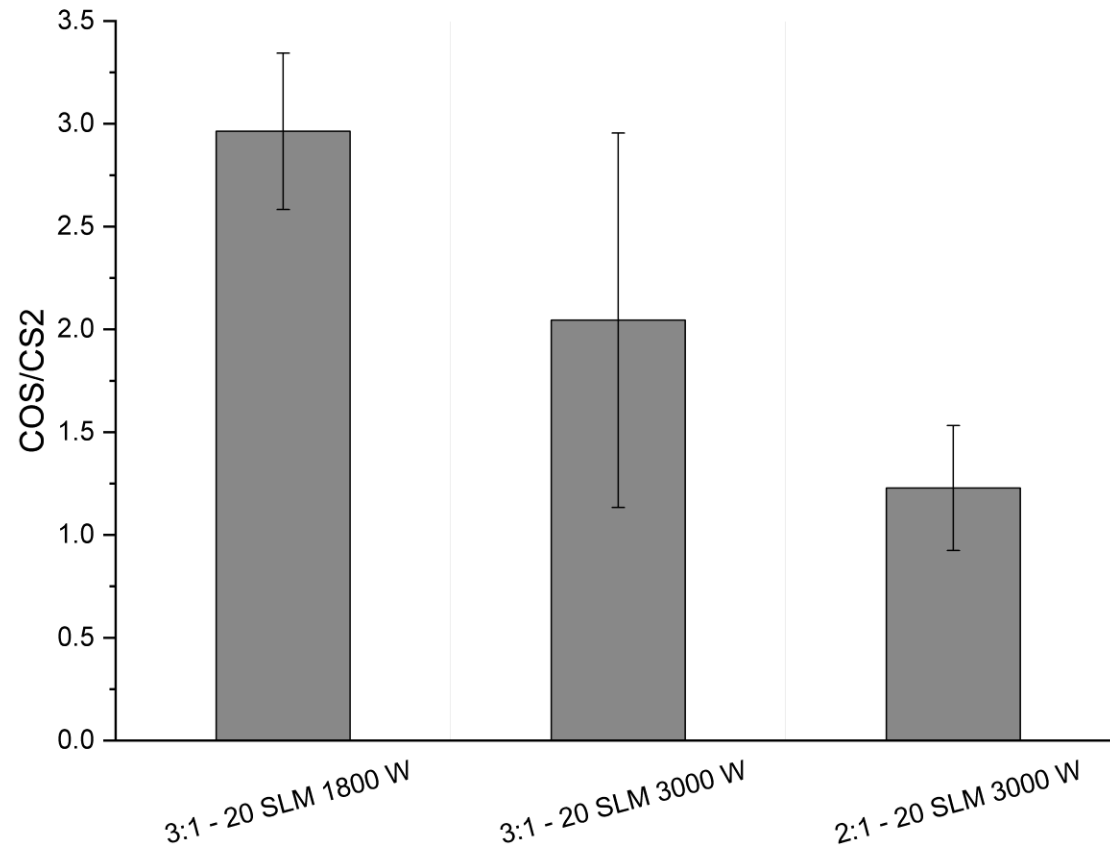
Energy consumption



Water electrolysis: 50-60 kWh/kg_{H2}

MW plasma DRM – results

Fate of H₂S



Research Conclusion and Future Perspectives

- MW plasma DRM presents a promising and environmentally friendly method for syngas production.
- High $\text{CO}_2:\text{CH}_4$ ratios mitigate the soot problem but at the cost of lower H_2 output due to the RWGS reaction.
- In MW plasma environment, H_2S is converted into COS and CS_2 , making the removal of H_2S before the process an advised approach.
- Substituting part of CO_2 with steam should limit the RWGS reaction impact and provide an additional pool of H_2 , yet still mitigate the soot issue.

THANK YOU!

Any Questions?

Acknowledgements

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