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CTF@MWCNT: A Novel Metal-free Porous Electrocatalyst for the Electrochemical Reduction of CO_2

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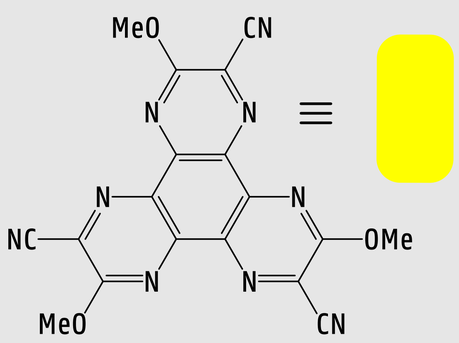
The electrochemical reduction of CO_2 to CO and other industrially valuable products is generally catalysed by noble metals. Recent studies have investigated metal-free catalysts, mainly nitrogen doped carbons. This work proposes a new and versatile class of metal-free electrocatalyst: CTF@MWCNT, a hybrid nanostructure consisting of highly porous covalent triazine frameworks, covalently bound to conductive multiwalled carbon nanotubes, thus combining the best of two worlds.

Covalent Triazine Frameworks (CTFs)

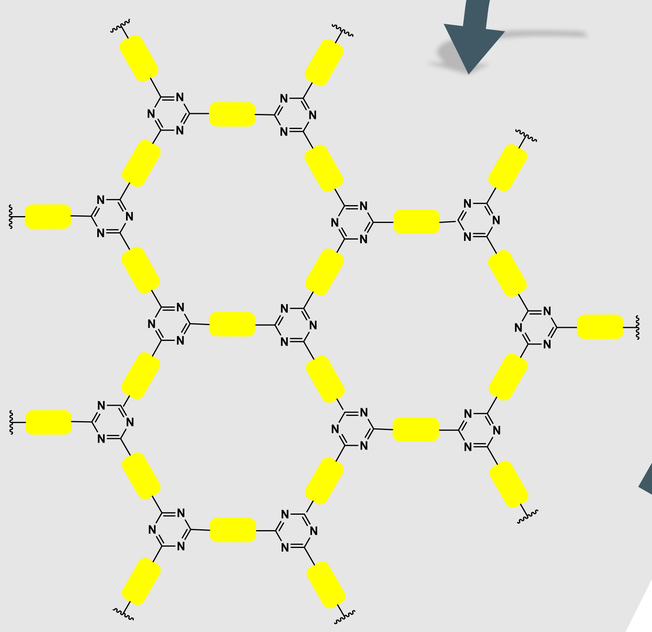
porous – robust – metal-free – lightweight – versatile

but not conductive

nitrile trimerization
$ZnCl_2$, 500° C

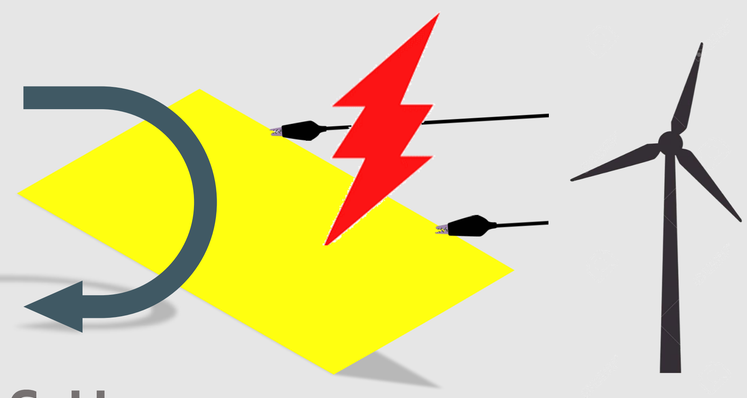


rich in pyridinic nitrogen



Electrochemical CO_2 reduction

$CO_2 + H_2O$

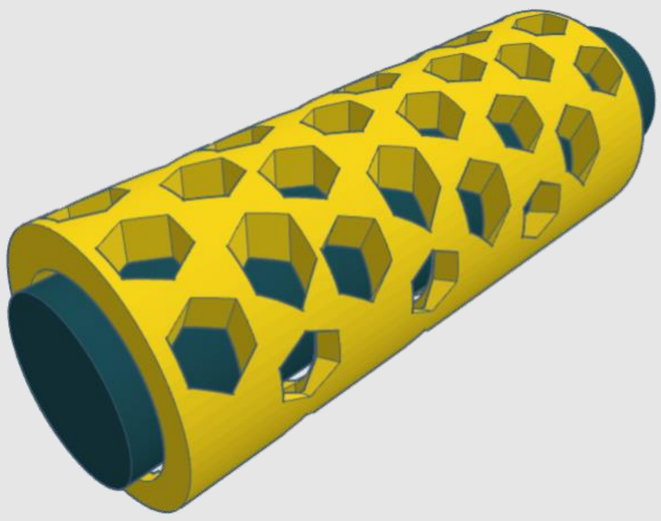


CO, $HCOOH$

CH_4, CH_3OH, C_2H_6...

CTF@MWCNT

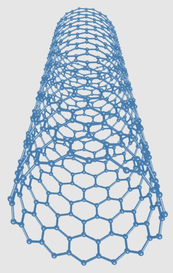
porous – conductive – metal-free



A layer of CTF covalently bound to a multiwalled carbon nanotube

Carbon nanotubes

- conductive support
- multiwalled
- surface functionalized with OH or CN groups



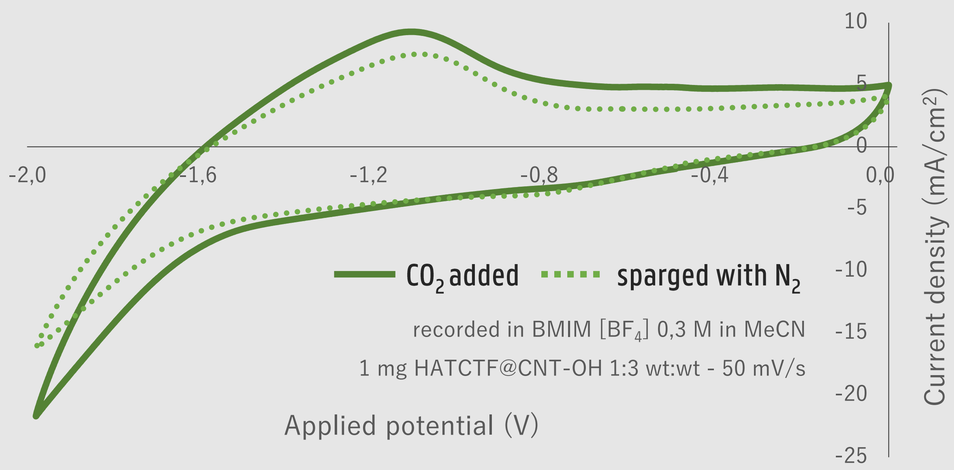
Electrocatalyst

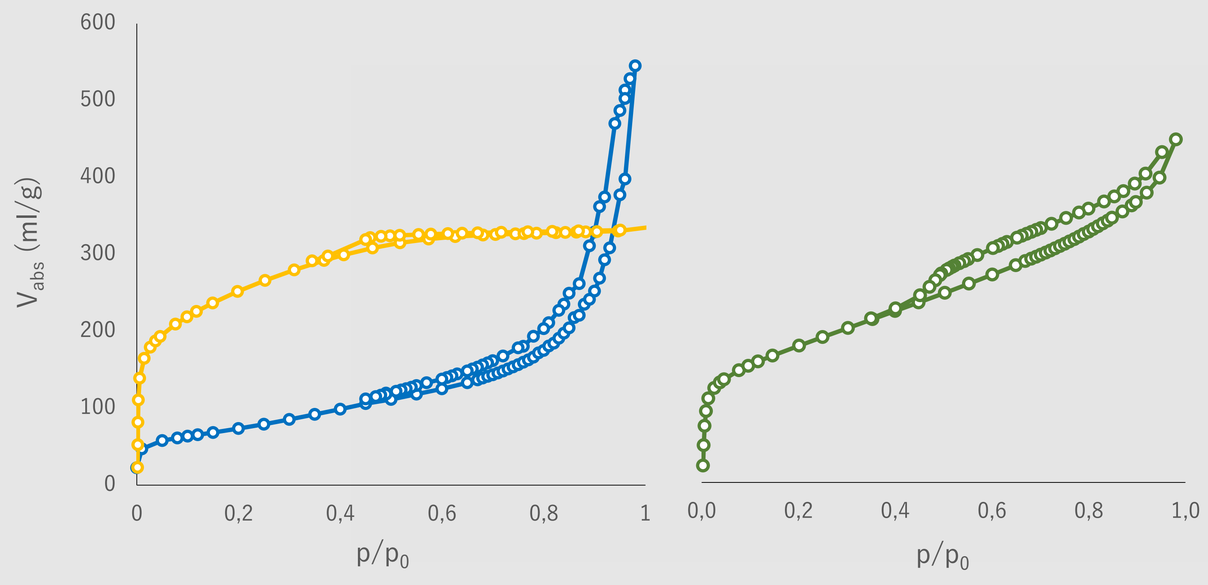
- noble metals
  expensive, not green
- nitrogen doped carbons
  lack well-defined active sites

N_2-sorption analysis

HAT-CTF	900 m^2/g
MWCNT-OH	263 m^2/g
HAT-CTF@MWCNT-OH 2:3 wt:wt	658 m^2/g

Cyclic voltammetry





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