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Carbon Nanotubes and Porous Organic Polymers for CO_2 Capture

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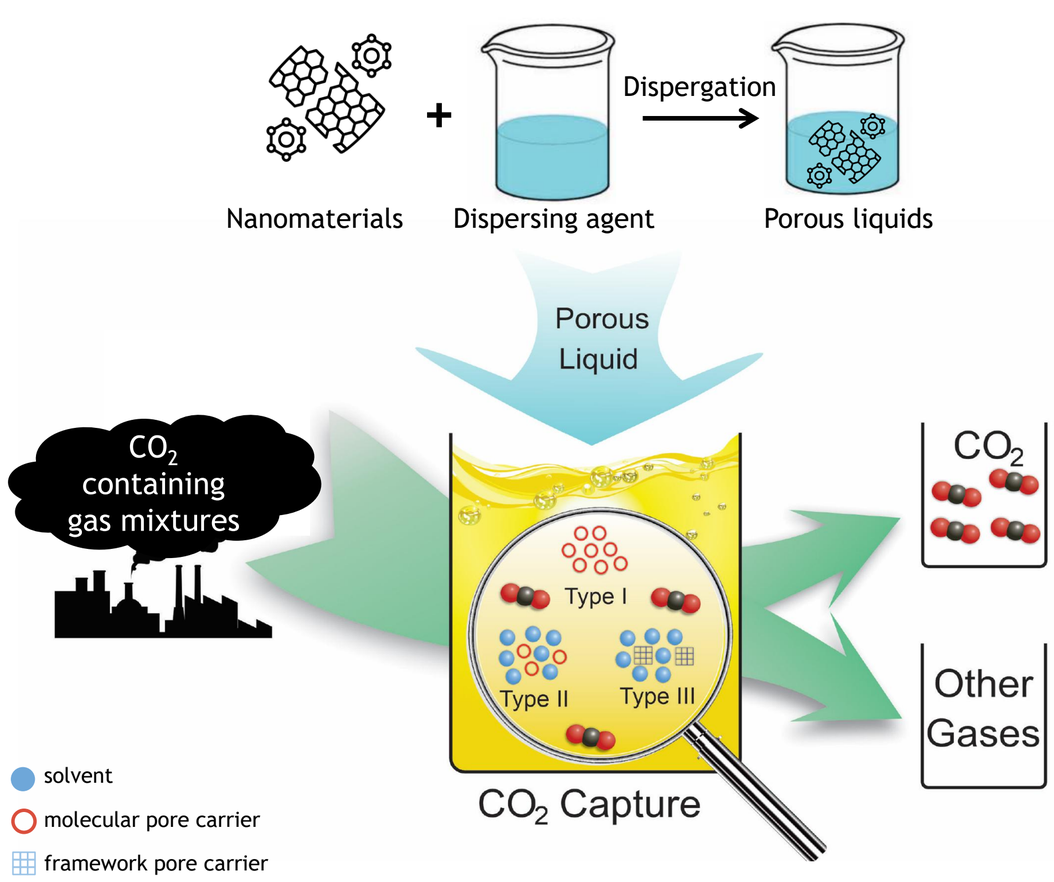
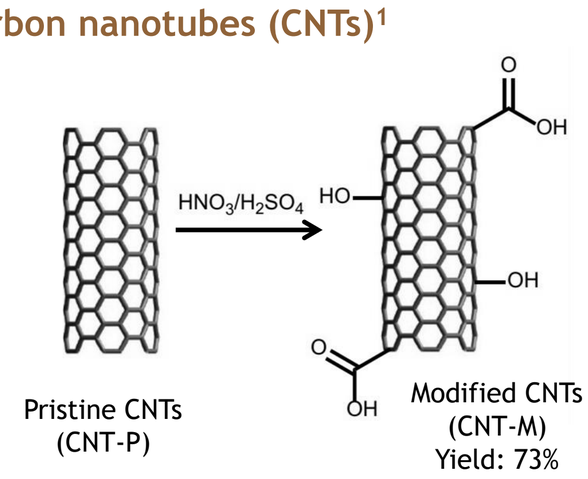
INTRODUCTION & AIM



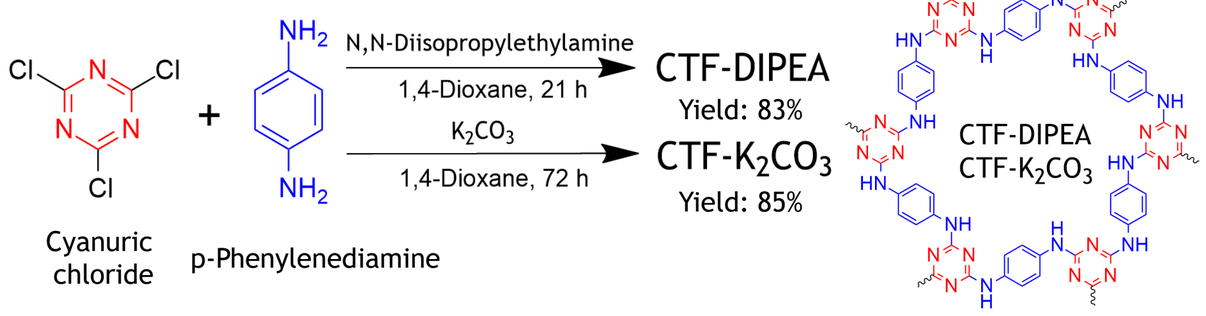
Porous liquids, containing porous adsorbent dispersed in compatible fluid, represent promising approach for CO_2 capture from CO_2 containing gas mixtures.

SYNTHESIS OF NANOMATERIALS

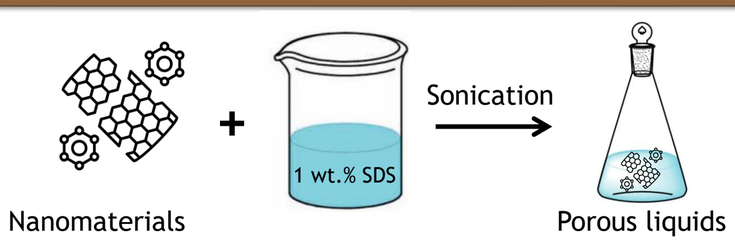
Oxidation of carbon nanotubes (CNTs)[1]



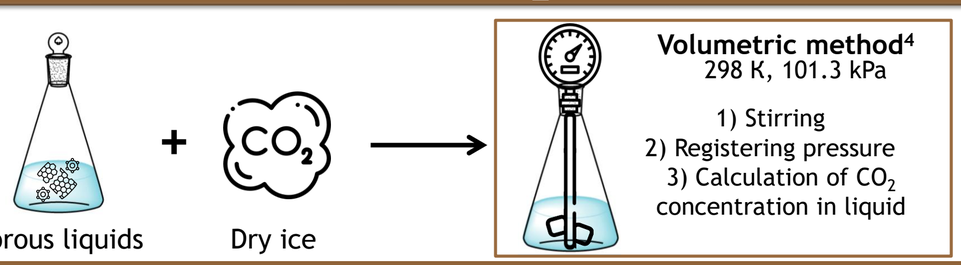
Synthesis of covalent triazine frameworks (CTFs)[2,3]



FORMULATION OF POROUS LIQUIDS

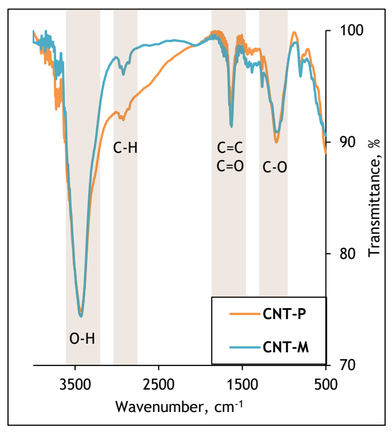


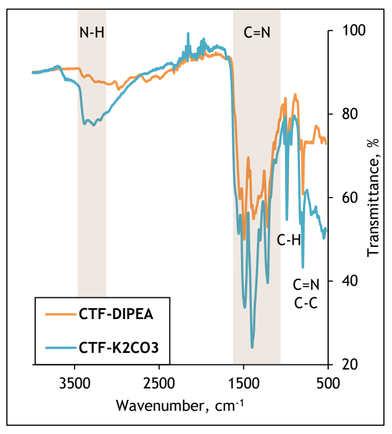
MEASUREMENT OF CO_2 UPTAKE



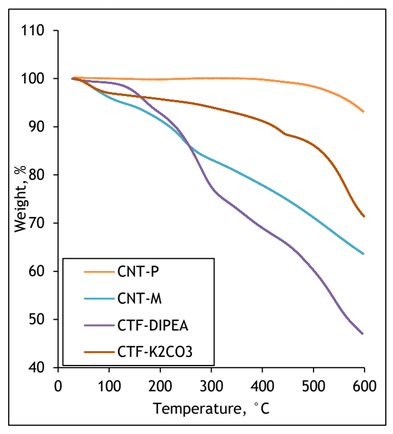
RESULTS & DISCUSSION

FT-IR characterization





Thermogravimetric analysis

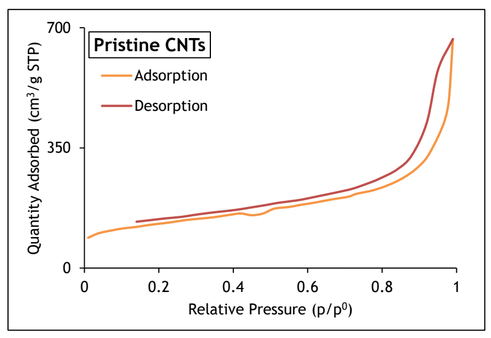


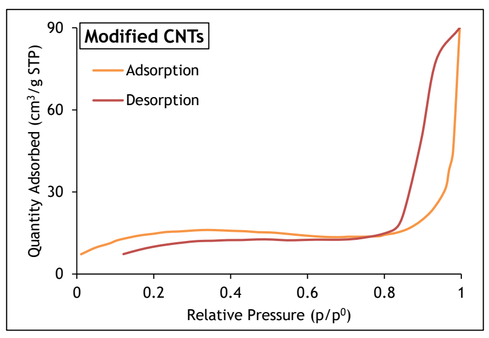
FT-IR: Successful modification of CNTs and formation of CTFs is confirmed.

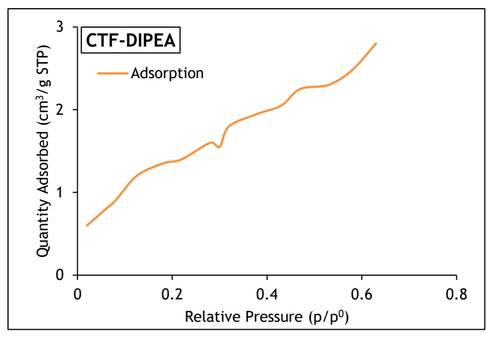
TGA:

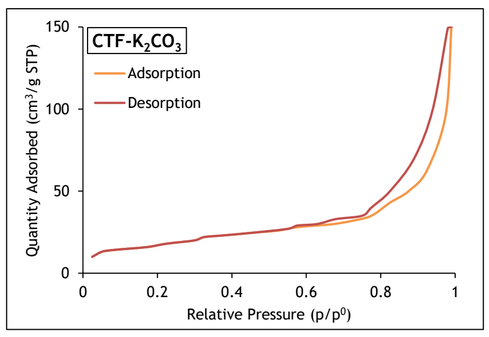
- Pristine CNTs exhibit the highest thermal stability;
- Chemical modification of the CNTs leads to reduced stability;
- CTF-DIPEA demonstrates the poorest thermal stability.

N_2 isotherm linear plots of nanomaterials

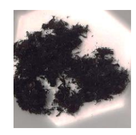




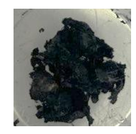




CNT-P

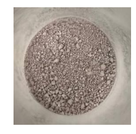


CNT-M



CTF-DIPEA

$CTF-K_2CO_3$



Characterization of nanomaterials and liquid systems

Liquid media	Nanomaterial	BET surface area of nanomaterial, m^2/g	CO_2 uptake of liquid, mmol/L
Water	—	—	19
1 wt.% SDS	—	—	38
	CNT-P (0.004 wt.%)	460.6	64
	CNT-M (0.004 wt.%)	73.9	69
	CTF-DIPEA (0.004 wt.%)	23.1	82
	$CTF-K_2CO_3$ (0.004 wt.%)	64.7	76

CO_2 uptake of liquids:

CNTs suspensions: 70-80% increase in CO_2 uptake vs. 1 wt.% SDS.

CTFs suspensions: 100-110% increase in CO_2 uptake vs. 1 wt.% SDS.

CONCLUSION

Porous liquids enhance CO_2 capture due to porous nature of nanomaterials.

Our findings demonstrate that:

- Surfactants improve CO_2 dissolution, doubling CO_2 uptake compared to pure water;
- Dispersing commercial CNTs enhances CO_2 capture over the water-surfactant solution. Modification of CNTs increases CO_2 dissolution in porous liquid;
- Covalent triazine frameworks result in two times higher CO_2 uptake compared to water-surfactant.

FUTURE WORK

- Optimize nanomaterials synthesis for better CO_2 uptake;
- Evaluate the possibility of porous liquids regeneration and reuse;
- Investigate the influence of polar groups on CO_2 capture.

REFERENCES

1. Kobashi, K. et al. *ACS Appl. Nano Mater.* **2021**, 4, 5273.
2. Gopi, S. et al. *Polymer* **2017**, 109, 315.
3. Kundu, S.K. et al. *RSC Adv.* **2015**, 5, 32730.
4. Truong, T. et al. *Food Chem.* **2017**, 237, 667.

SDS - Sodium dodecyl sulfate