# Characterization and adsorption potential of Lignosulfonate-based activated carbon fibers

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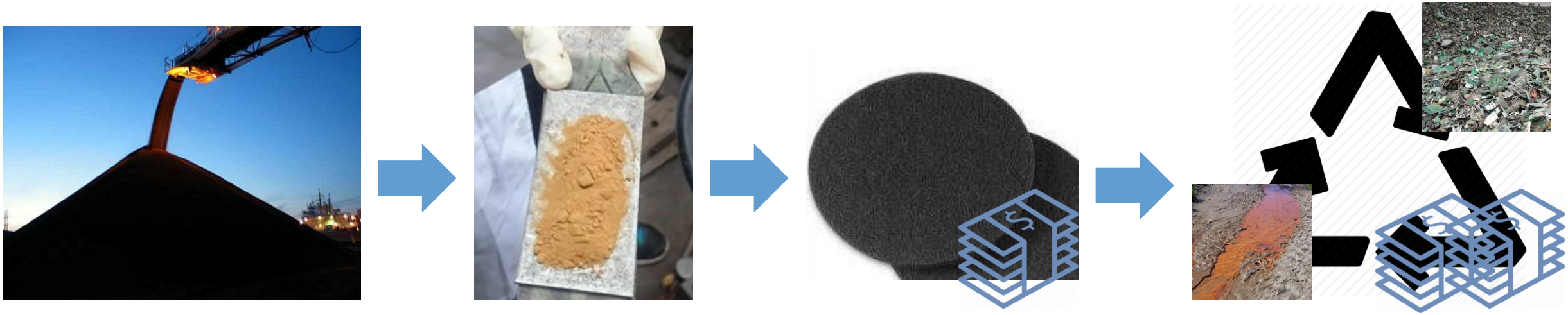
# Outline

- Introduction
- Materials & Methods
- Results & Discussions
- Future Works

# Introduction

- Why lignosulfonte-based activated carbon fiber & adsorption?



- Goal—Characterize properties → investigate its adsorption potential

# Preparation of Activated Carbon Fiber

# Materials

- Hardwood lignosulfonate (HLS)

  Polyethylene oxide (PEO) (95:5)

  $+\mathrm{d}H_2O$

  →30 wt% mixture

- @Room Temp, stir until dissolve

# Methods—Production of Activated Carbon Fiber

Electrospinning → Preoxidation → Carbonization & Activation → Product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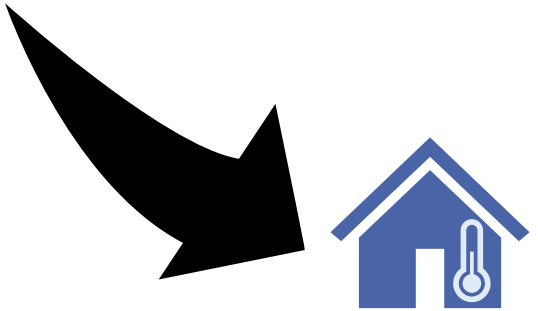
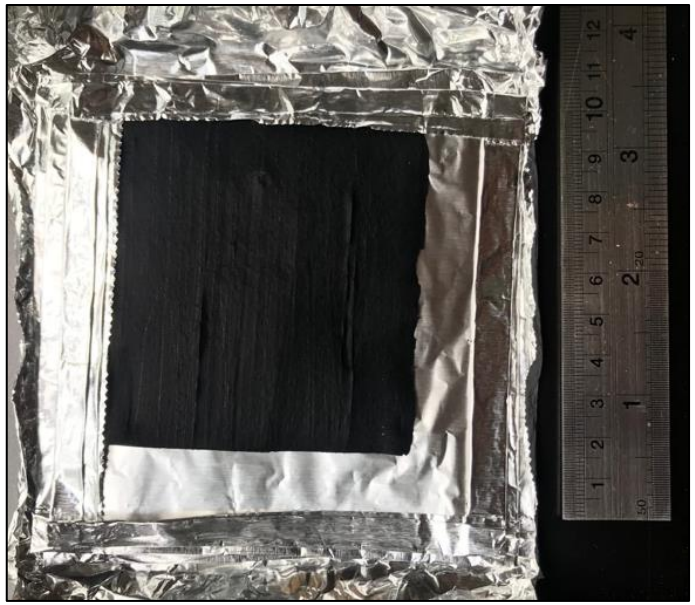
(1) @ 1 ℃/min,
100℃ (30 min)
(2) @ 1 ℃/min,
300℃ (30 min)





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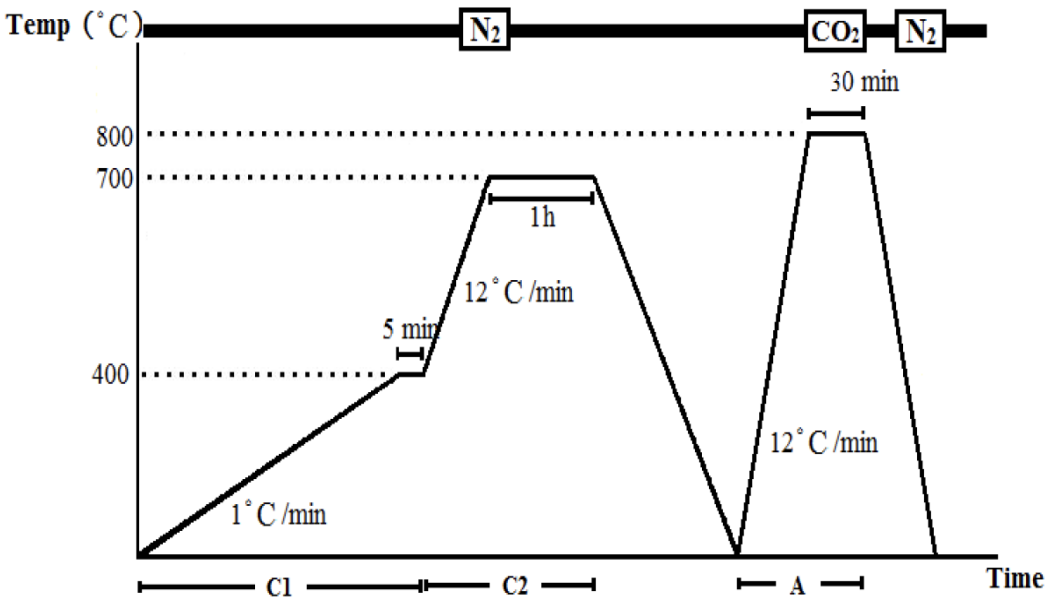



# Analytical Methods

# Factors influence adsorption ability

- Morphology → affect interactions between adsorbates and adsorbents
- Specific surface area → larger, greater potential
- Pore size distribution → adsorb substances with similar diameter
- Surface properties → electrons on the surface are helpful

# Methods—Characterization of Activated Carbon Fiber

## Physical Characterization

- Scanning Electron Microscopy (SEM)
  Fiber Morphology
- BET Analysis
  ($N_2$@77K)
  Pore structure & Surface Area
- Quenched solid density functional theory (QSDFT)
  Pore Size Distribution

## Chemical Characterization

- Raman Spectroscopy
  $sp^2$ electron

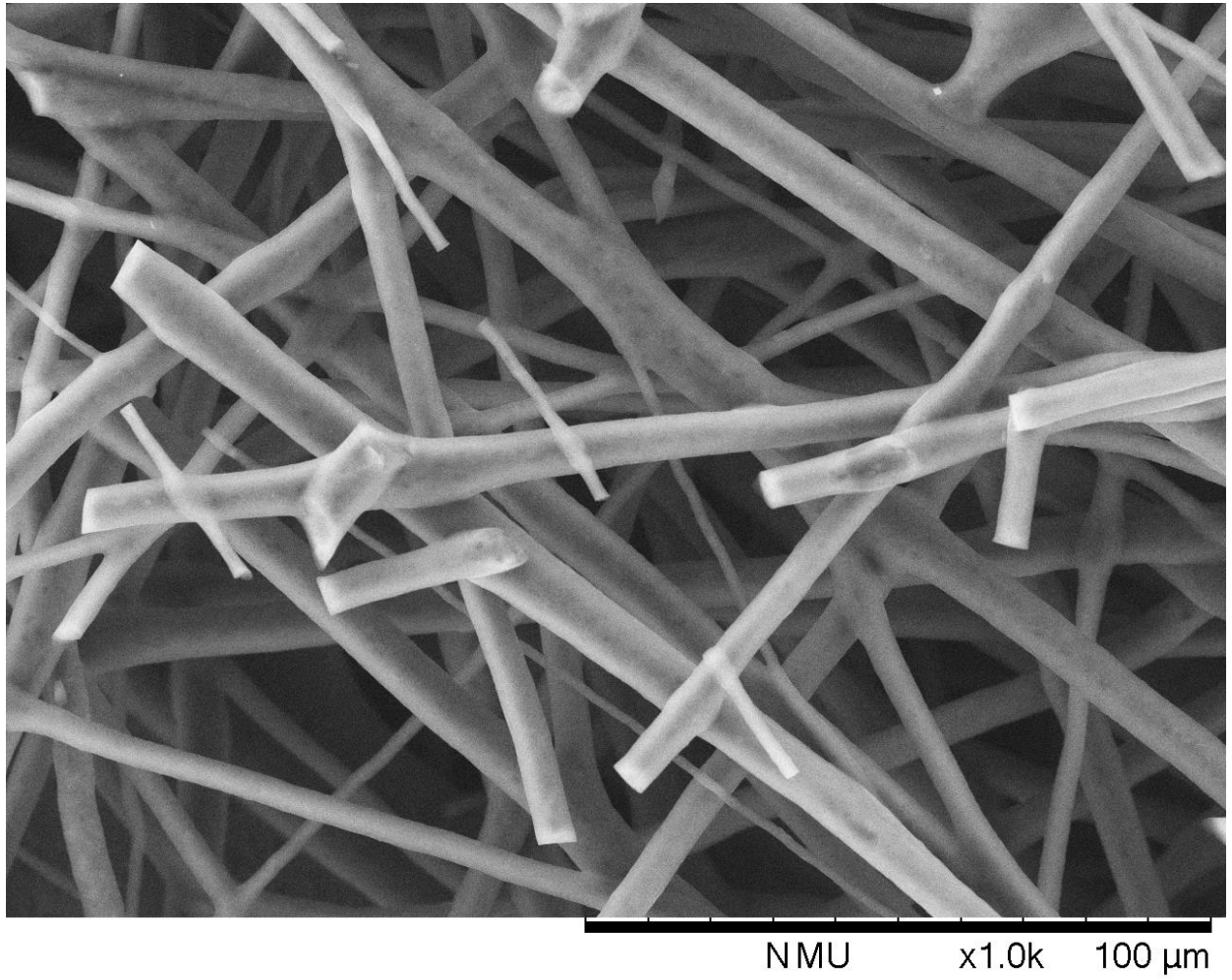
# Results and Discussions

(Marsh and Rodríguez-Reinoso, 2006)

# Physical Characterization – Fiber Morphology (SEM)

- Morphology

1) Fiber Fusion → diameter varies → Various pore size
2) Defective nest-like structure → Dispersive forces



(Thommes *et al.*, 2015)

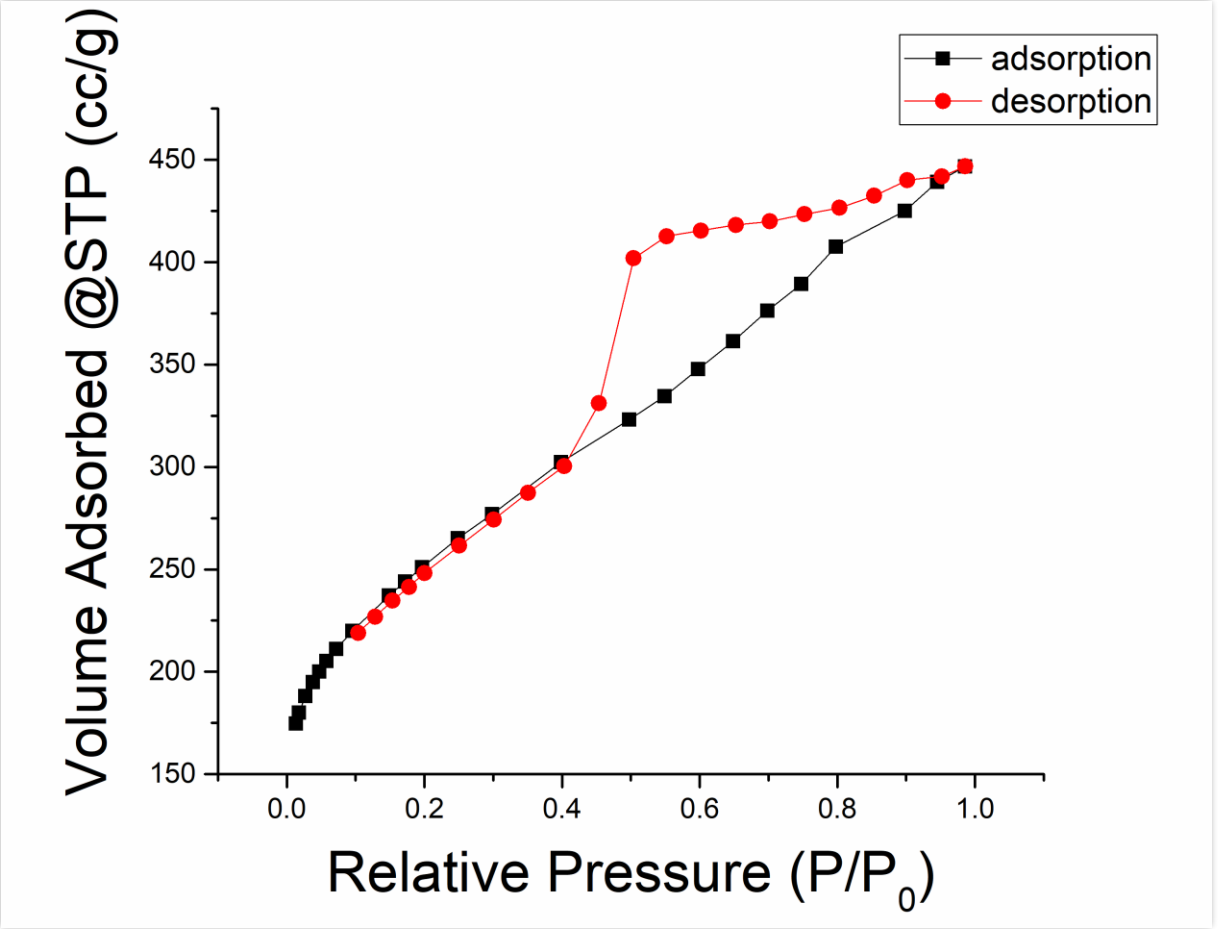
# Physical Characterization – Structure (BET)

- Pore structure

1) IUPAC: Mesopores (Major)
2) Bottleneck-like pore connection

- Specific Surface Area

≈ 350 - 900($m^2/g$)



(Volkov *et al.*, 1997)

# Physical Characterization – Pore Size (QSDFT model)

- Pore Size Distribution

1) Total Pore Volume

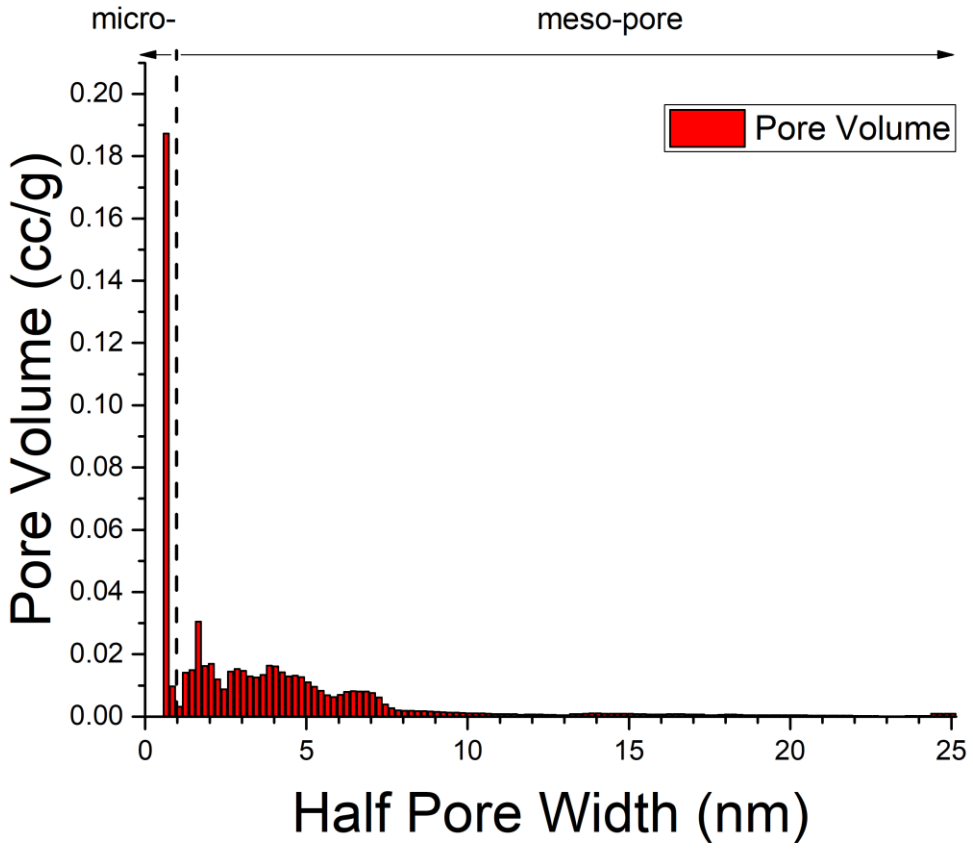
≈ 0.21 – 0.65 $cm^3/g$

2) Micro/Mesopore (%)

≈ 30/70

3) Mainly 1.6 – 20 nm

4) Hydrated metal ions' diameter → within micropore region



(Yen and Chang, 2016; Peng *et al.*, 2017)

# Chemical Characterization – $\pi$ electron on surface

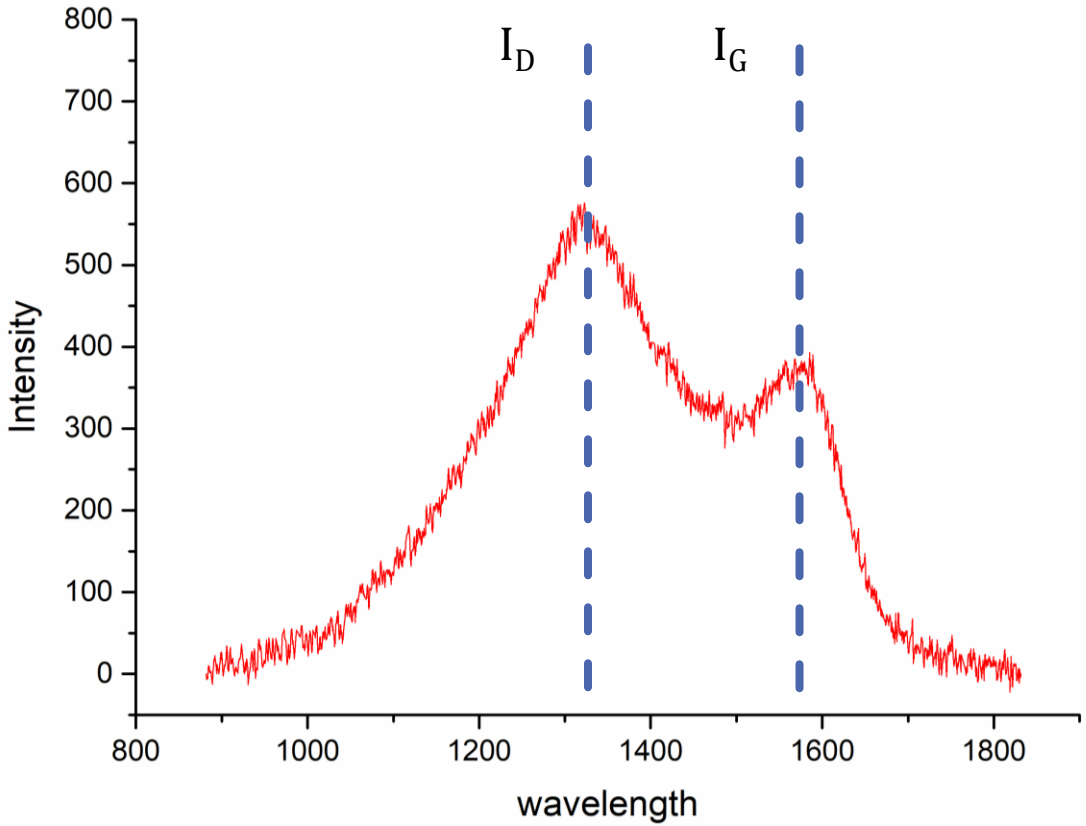
- Carbon Content ($\approx$ 50%)
- Raman Spectroscopy

(1) Further investigate C's structure

(2) $I_D$(Graphite, C-C, $sp^3$), around 1350 $cm^{-1}$

(3) $I_G$(Graphene, C=C, $sp^2$), around 1580 $cm^{-1}$

(4) $I_D/I_G$ <1, though $I_G$ less → electron rich regions exist → beneficial to adsorption



# Conclusions and Future

# Conclusions and Future works

- Morphology → fiber structure creates forces to assist adsorption
- Specific surface area → large enough to perform adsorption
- Pore size distribution → similar diameter to adsorbates of interest
- Surface properties → electrons on surface assist adsorption
- LACF is a potential adsorbent!
- Future works: adsorption column test

  → study adsorption kinetics (metal ions)

# Thank you