Colloidal lignin particles: From industrial by-product to functional colloidal materials for a sustainable future

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Lignin is a major by-product of the pulp & paper industry

Challenges to upgrading lignin arise from its heterogeneous and complex structure

Understanding colloidal particle formation can open new pathways for utilization of bio-based byproducts

Methods

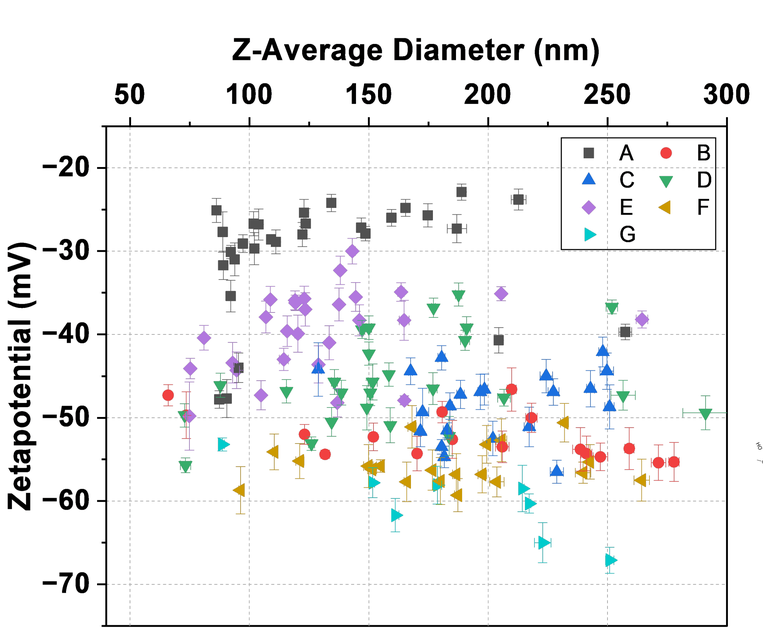
Seven different Kraft lignins

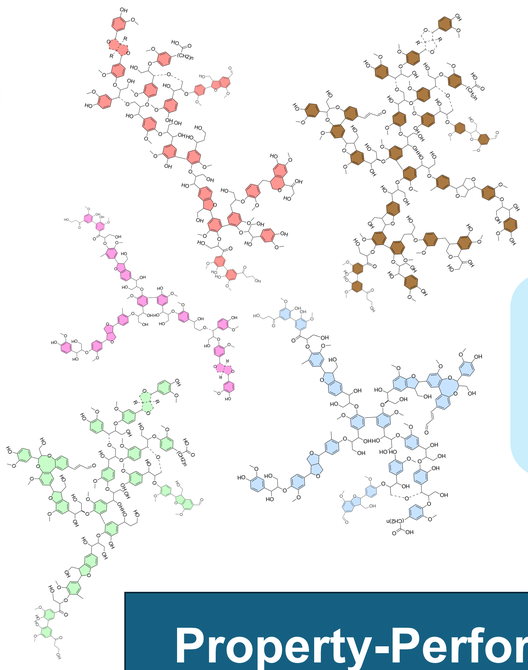
- Molecular weight
- Inter-unit linkages
- Functionality profile
- Impurities
- Monomer Composition
- pH

Structure-property Relationships

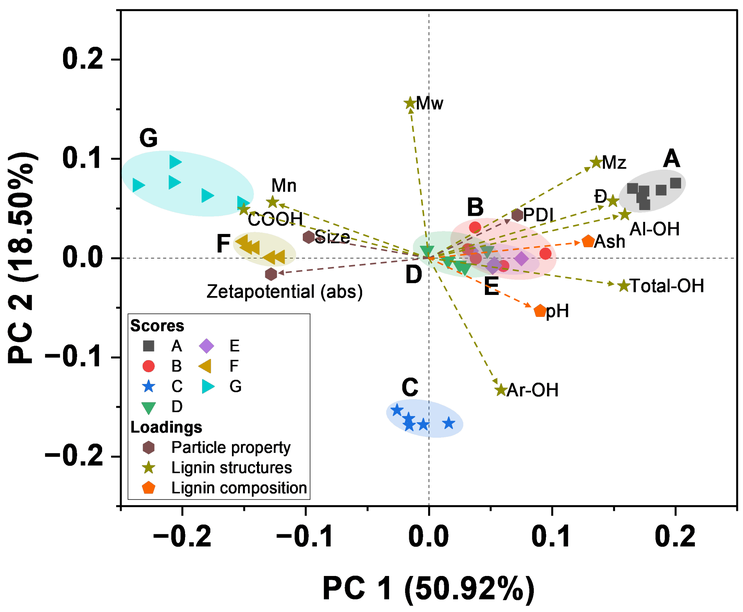
Lignin composition and structure impact the formation and properties of colloidal particles. Synthesis variables can be used to tune particle properties.

Manual Interpretation

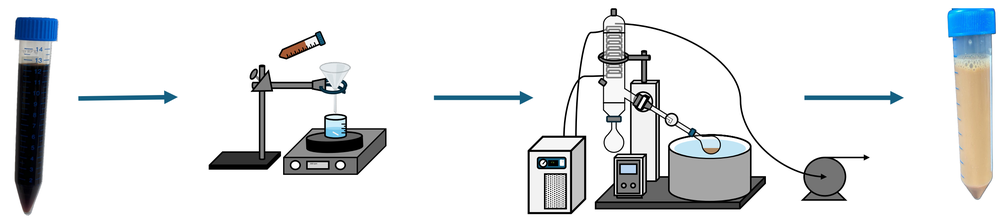




Multivariate Analysis (PCA Biplot)



Colloidal lignin particle synthesis



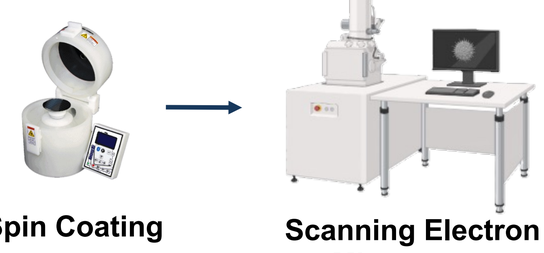
Lignin Solution → **Precipitation** → **Solvent Recovery** → **Colloidal Lignin Particles**

Particle properties can also be adjusted via synthesis variables

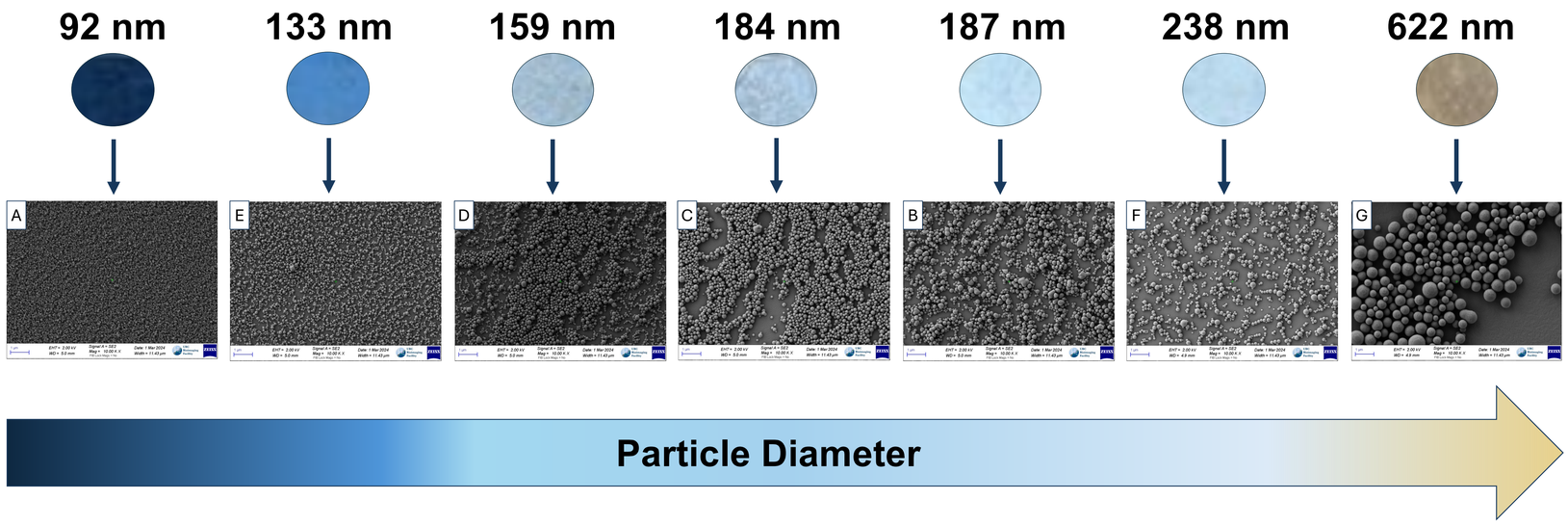
- Precipitation method
- Concentration
- Mixing rate
- Temperature
- Solvent & anti-solvent ratio
- Ion profile & pH

Property-Performance Relationships

Nano- and micro-scale differences in particle size have macroscopic impacts on lignin particle coatings.



Spin Coating → **Scanning Electron Microscope**



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