

# Morphological changes in cellulose and lignin components of biomass occur at different stages during steam pretreatment

## Approach:

- The Biofuels SFA uses of time-resolved neutron scattering to analyze disruption of structure of cellulose and lignin biomass components during steam explosion pretreatment.

## Objective:

- By performing in-situ time-resolved neutron scattering of biomass steam explosion pretreatment using a pressure reaction cell, we reveal the time relation in the stages of morphological changes of the cellulose and lignin biomass components.

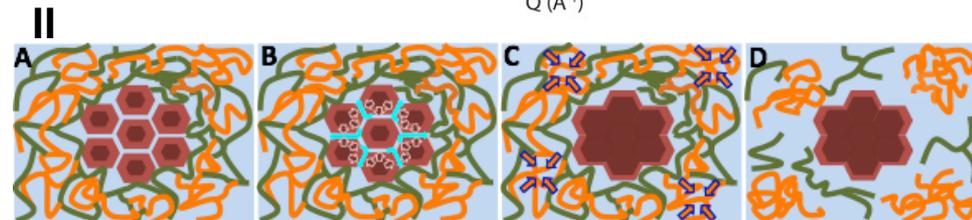
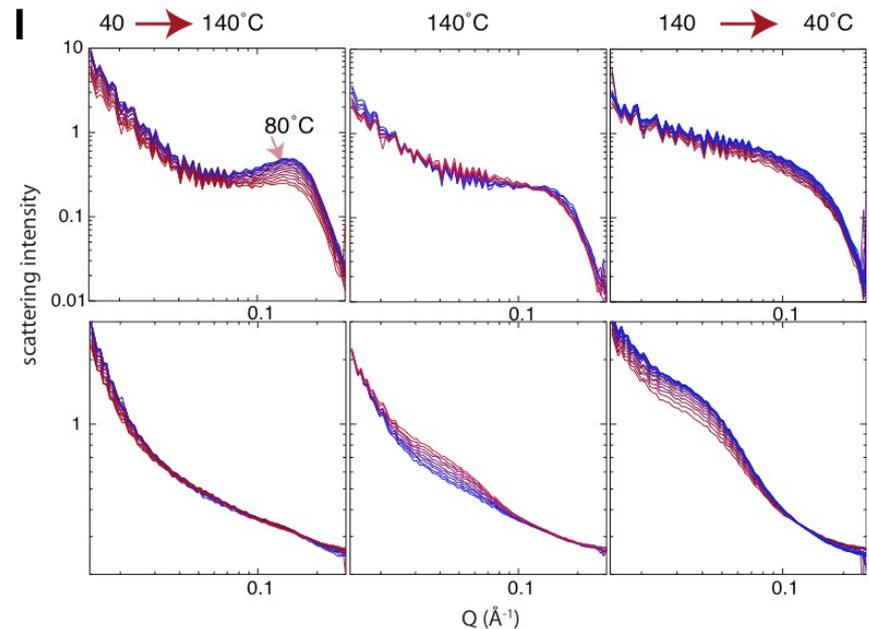
## Results:

- During the heating phase, water is expelled from the cellulose microfibrils as the elementary fibers coalesce. Minimal further changes observed during the holding and cooling phase (water expulsion irreversible).
- No change to lignin during heating phase, but aggregates begin to appear and increase in number during the holding phase. This process continues into the cooling phase.
- Lignin (poplar) phase separation from hemicellulose starts at or above  $\sim 140^\circ\text{C}$  during steam explosion pretreatment.

## Significance:

- This approach could be useful in optimizing the heating, holding and cooling stages of pretreatments to allow the exact size and nature of lignin aggregates to be controlled in order to enhance enzyme accessibility to cellulose and therefore the efficiency of biomass conversion.

(I) In-situ time-resolved neutron small-angle scattering data. Top row (horizontal sector) highlights cellulose morphological changes and bottom row (vertical sector) lignin. (II) A schematic summarizing the fundamental processes responsible for the morphological changes of cellulose and lignin components during steam explosion pretreatment.



SV Pingali, HM O'Neill, Y Nishiyama, L He, YB Melnichenko, V Urban, L Petridis, BH Davison, P Langan.  
"Morphological changes in the cellulose and lignin components of biomass occur at different stages during steam pretreatment" Cellulose Special Issue, in press (2014). Contact: [pingalis@ornl.gov](mailto:pingalis@ornl.gov).

# BER Biofuels SFA: Morphological changes in biomass components occur at different stages during steam pretreatment

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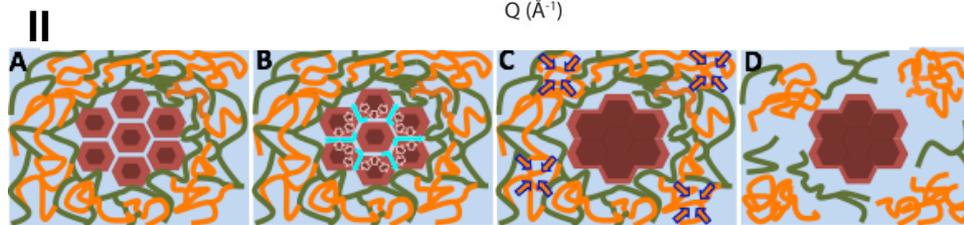
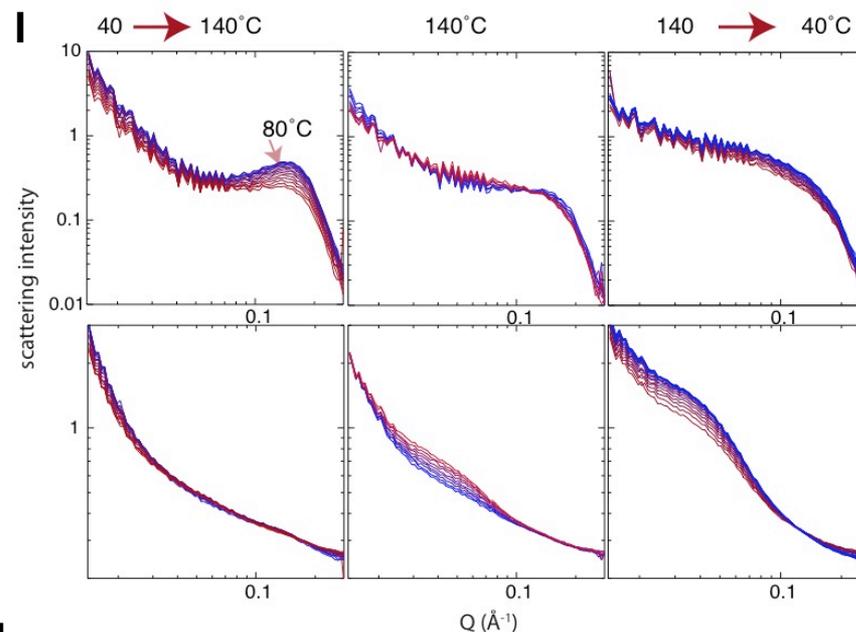
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