Plasticization Regimes in Biopolymers

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RENEWABLE MATERIALS
research group

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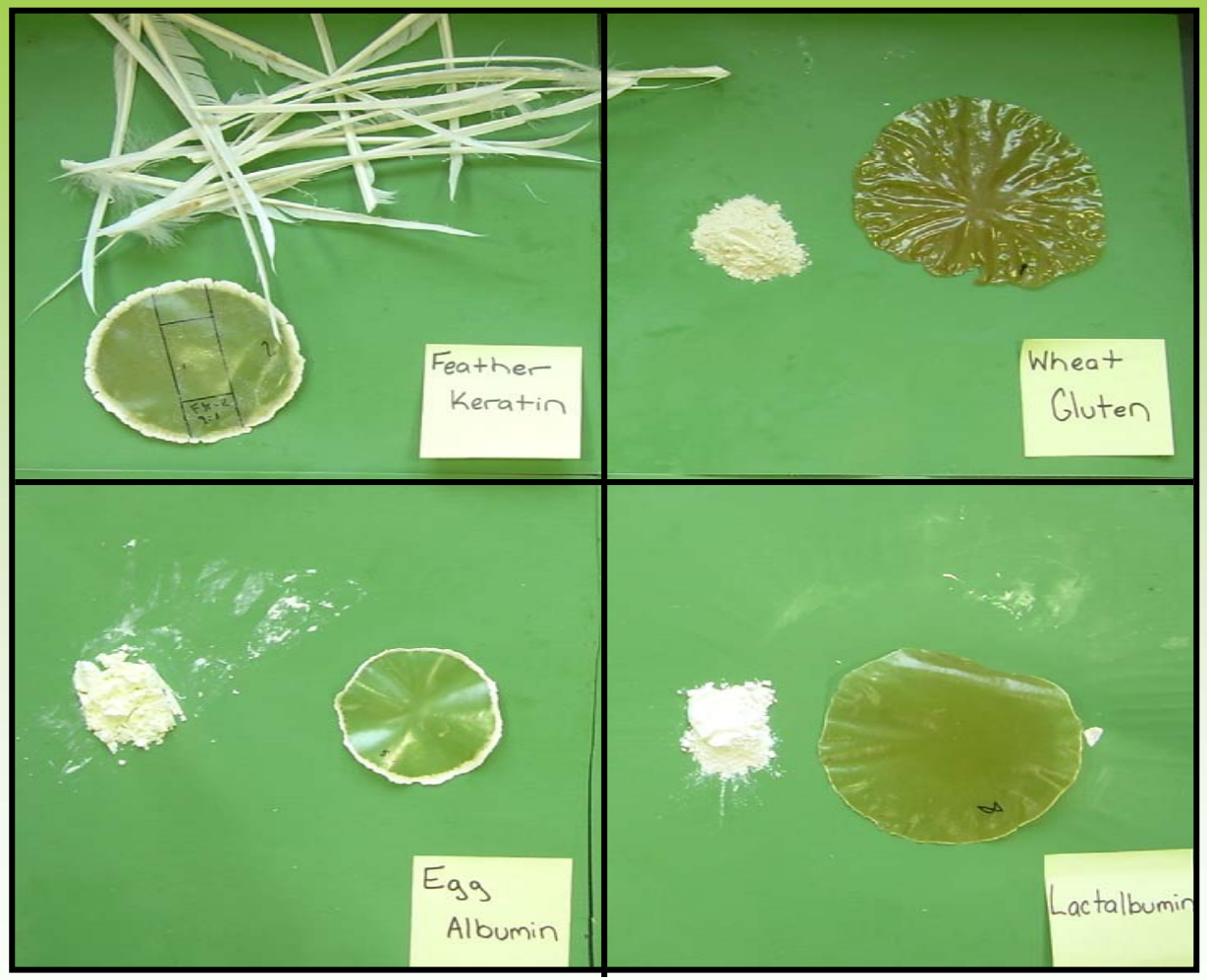
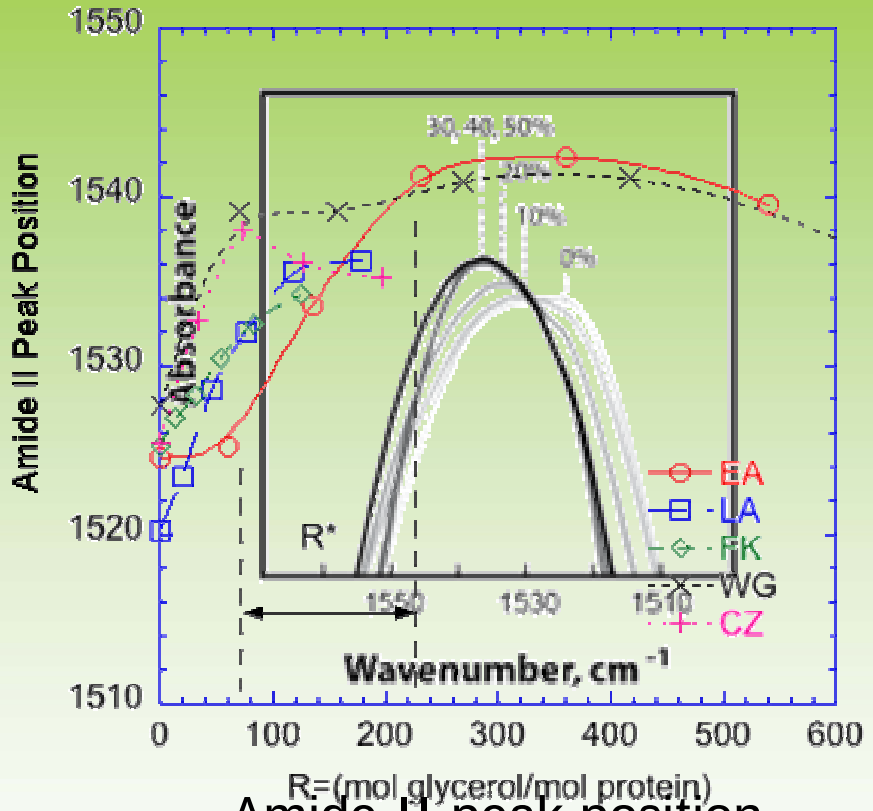
Motivation

- Proteins
  - Renewable feedstock
    - Abundant, readily separated in waste stream, chemically versatile molecules
- Glycerol plasticization: simple, tried and true technology
  - easy processing, enhances properties
  - Not fully understood

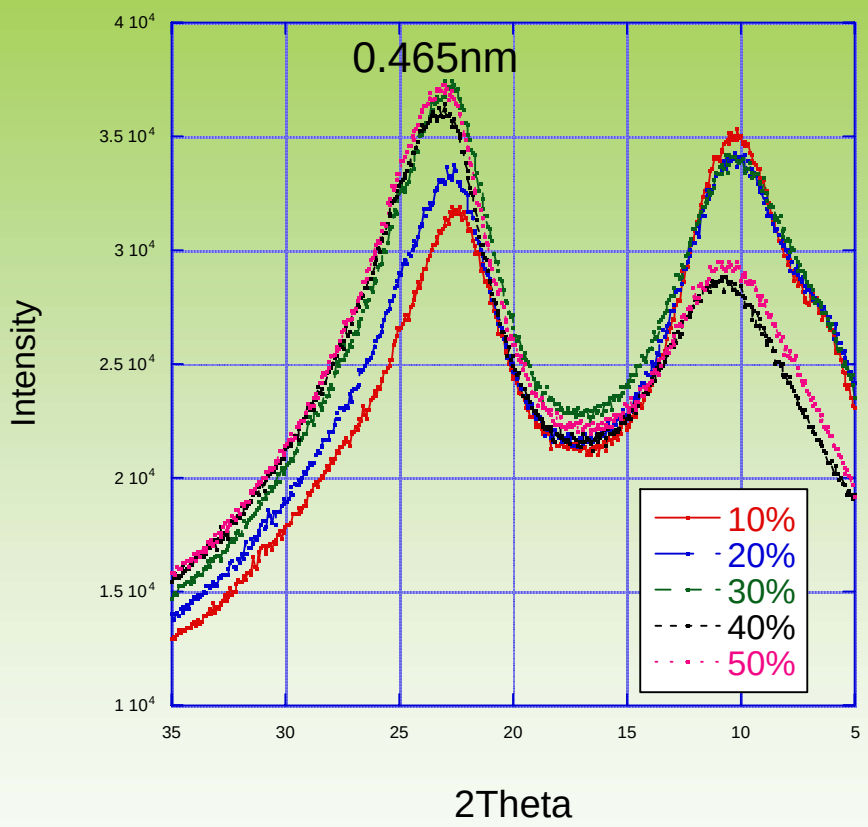
Technical approach



Glycerol effect on secondary structure

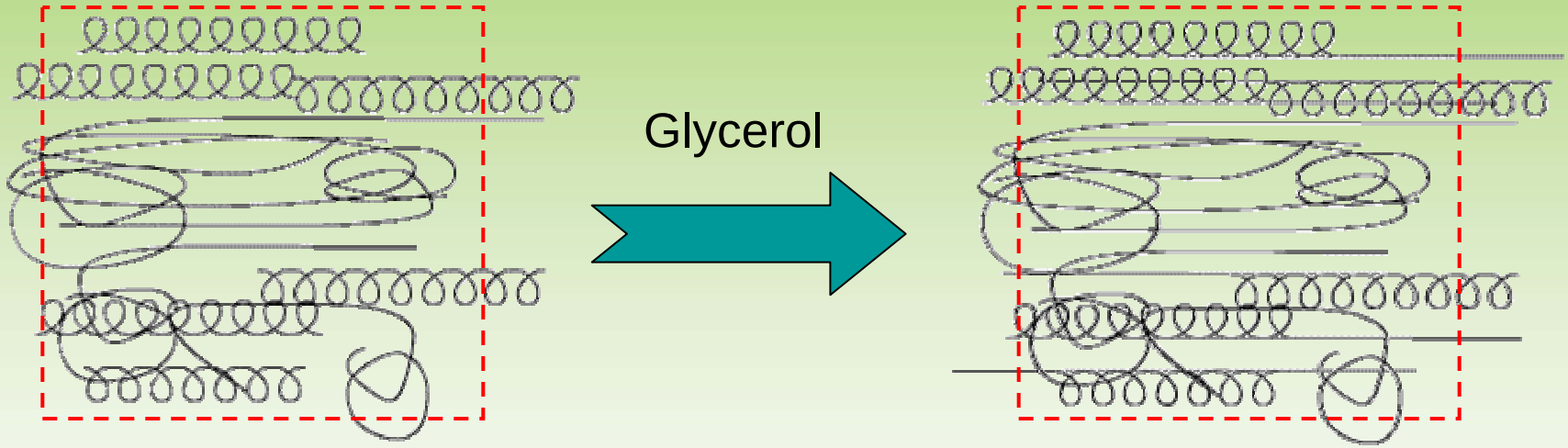


Amide II peak position of FK films made with varied %Glycerol



XRD patterns of FK films made with varied %Glycerol

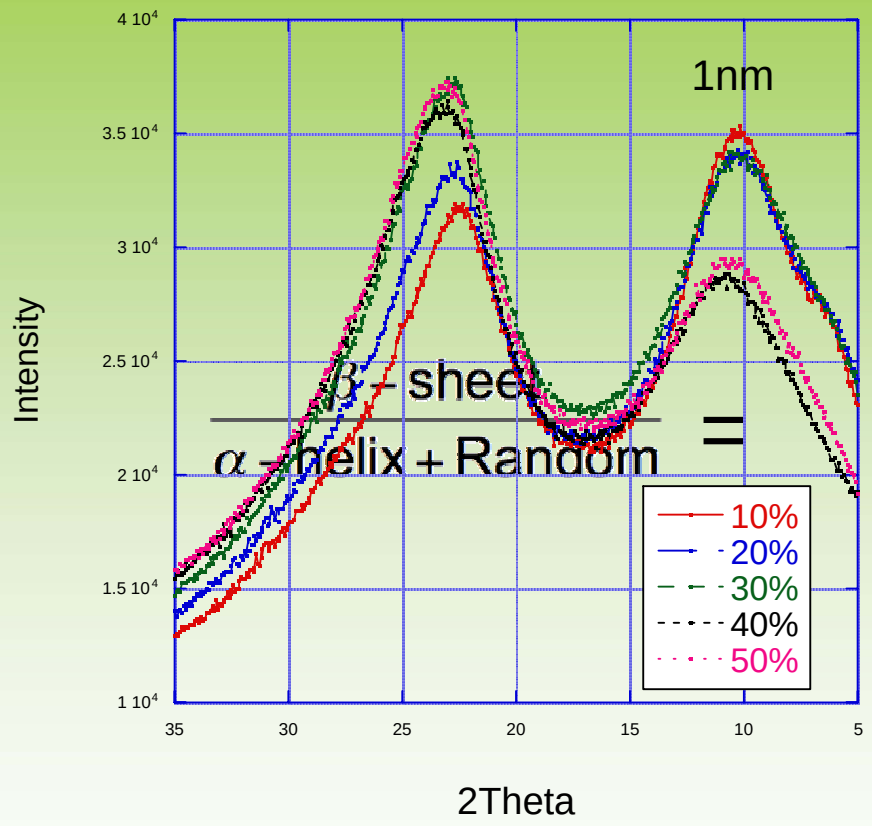
Protein plasticization with glycerol

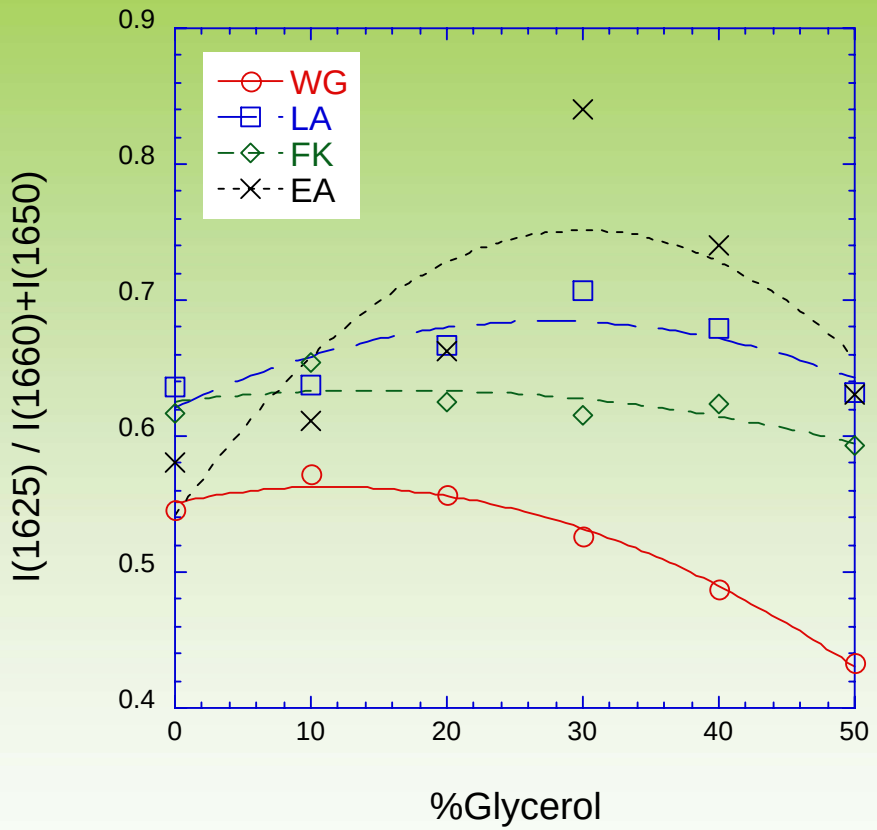


Dehydrated protein

Net change in secondary structure

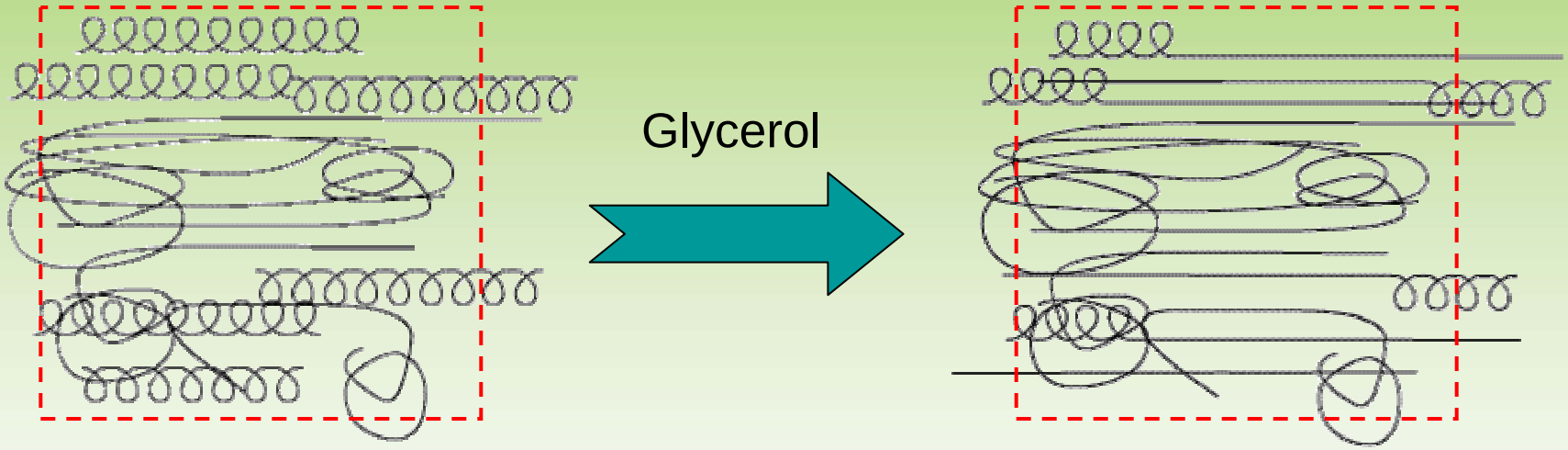
FTIR Amide I peak





XRD patterns of FK films made with varied %Glycerol

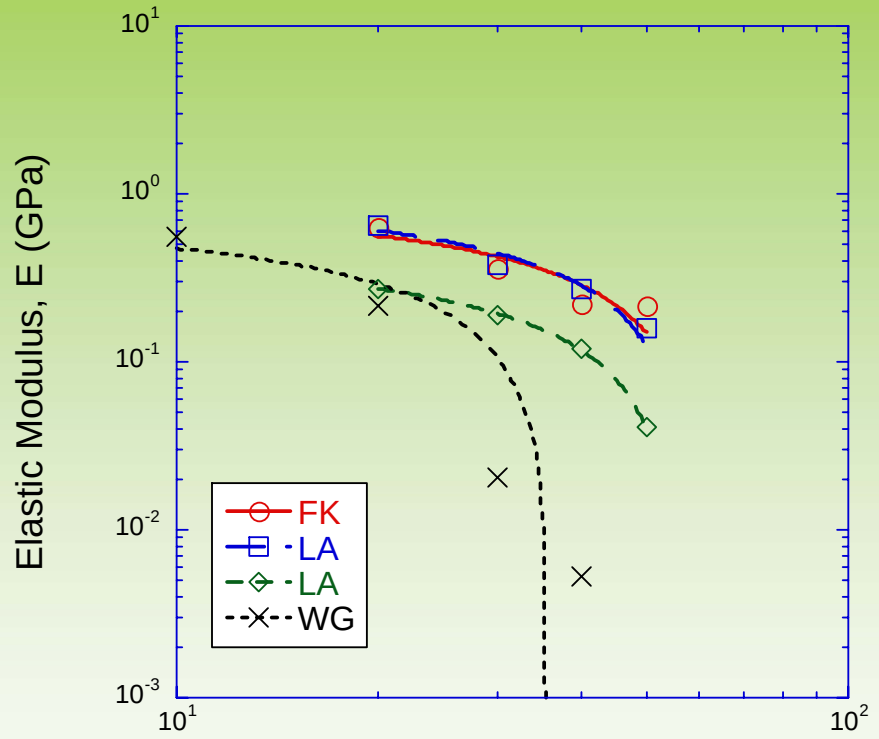
Using %Glycerol > c*

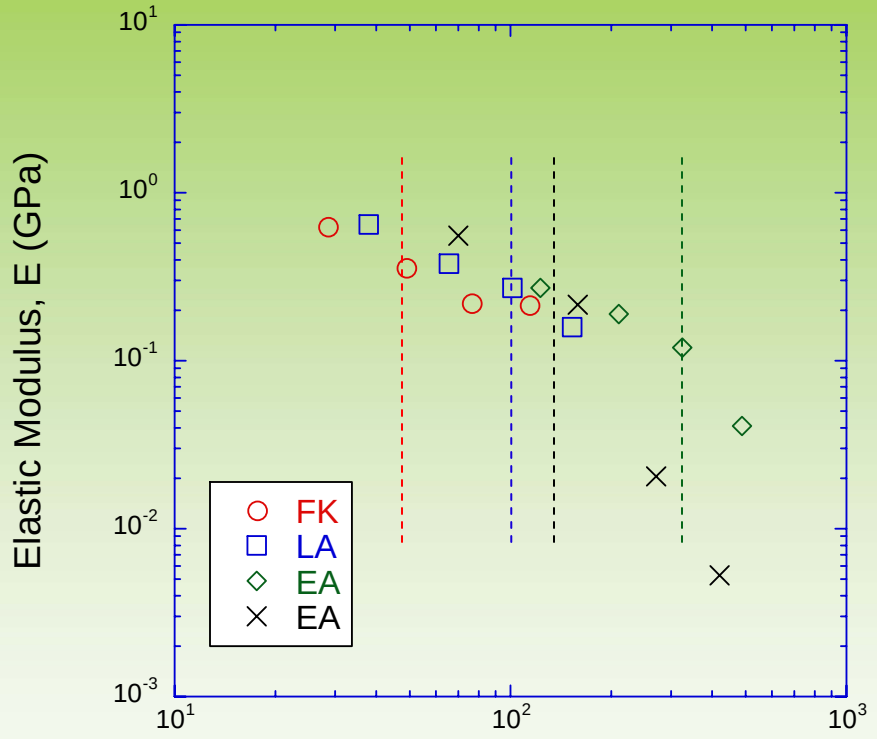


Dehydrated protein

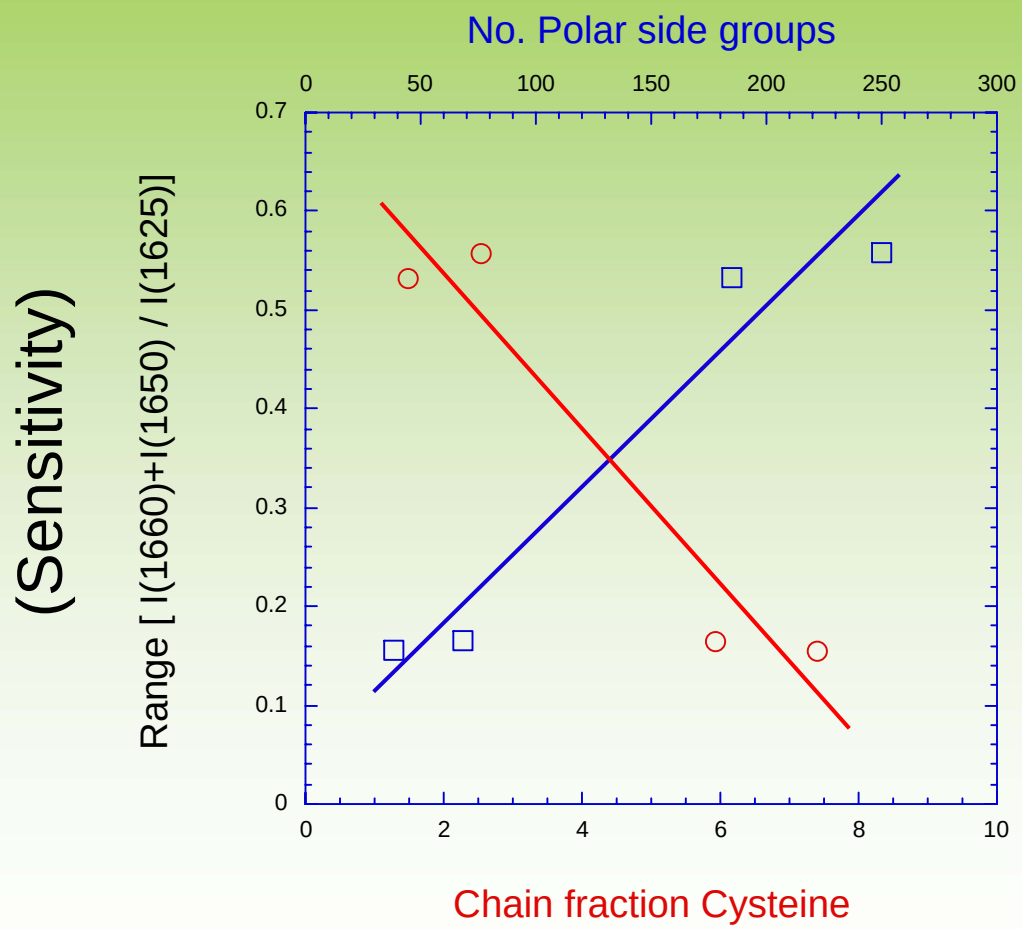
$$\frac{\beta - \text{sheet}}{\alpha - \text{helix} + \text{Random}}$$

Modulus vs. Glycerol - *





Sensitivity to plasticization vs. cysteine content and number polar side chains*



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Thermodynamic model

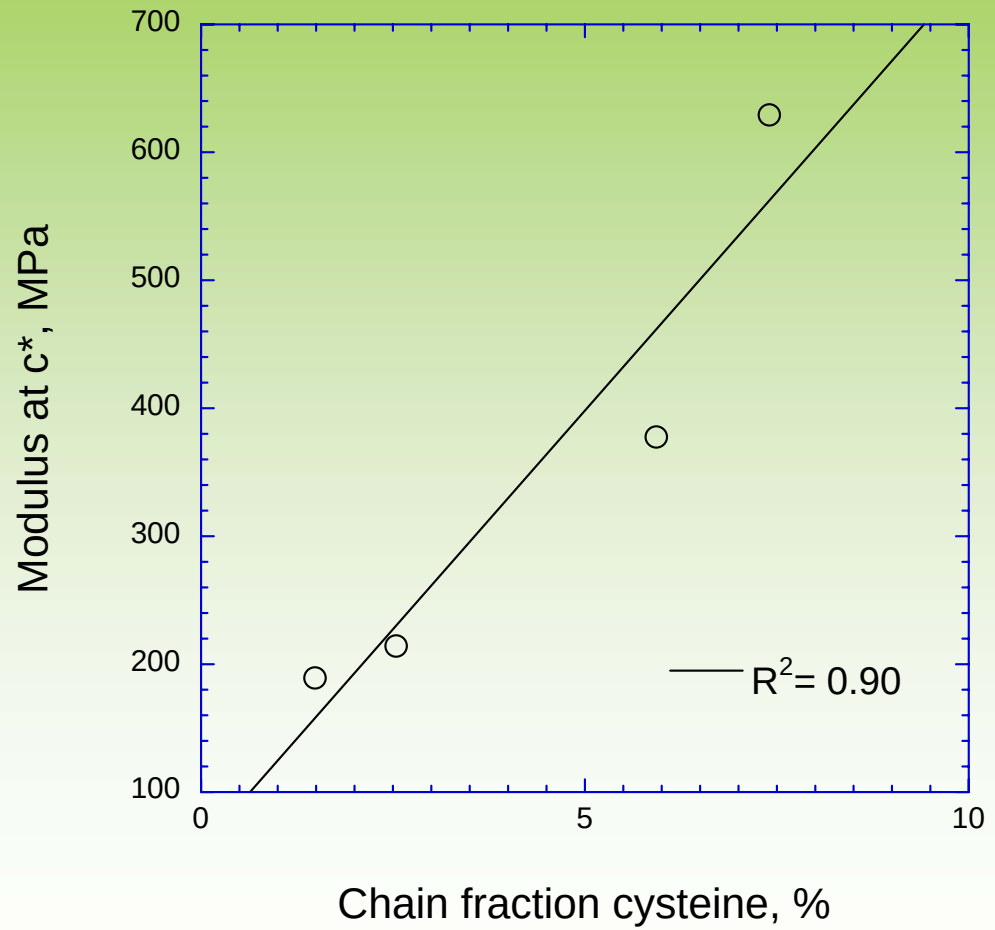
$$E \propto \rho \frac{RT}{Me}$$

$$\rho \propto \frac{1}{[Glycerol]}$$ = v.weak dep. ~ const.

$$Me \propto \frac{[Glycerol]}{[Cys]}$$

$$\Rightarrow E \propto RT \frac{[Cys]}{[Glycerol]}$$

Modulus at c* is function of cysteine content



$$E \propto RT\,[Cys]$$

Acknowledgment

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Questions?

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