Preparation and Characterization of rosin-based polymeric monomer

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Outline

1. Background of research

2. Past Research
   (Rosin based monomer and its application through Controlled living polymerization)

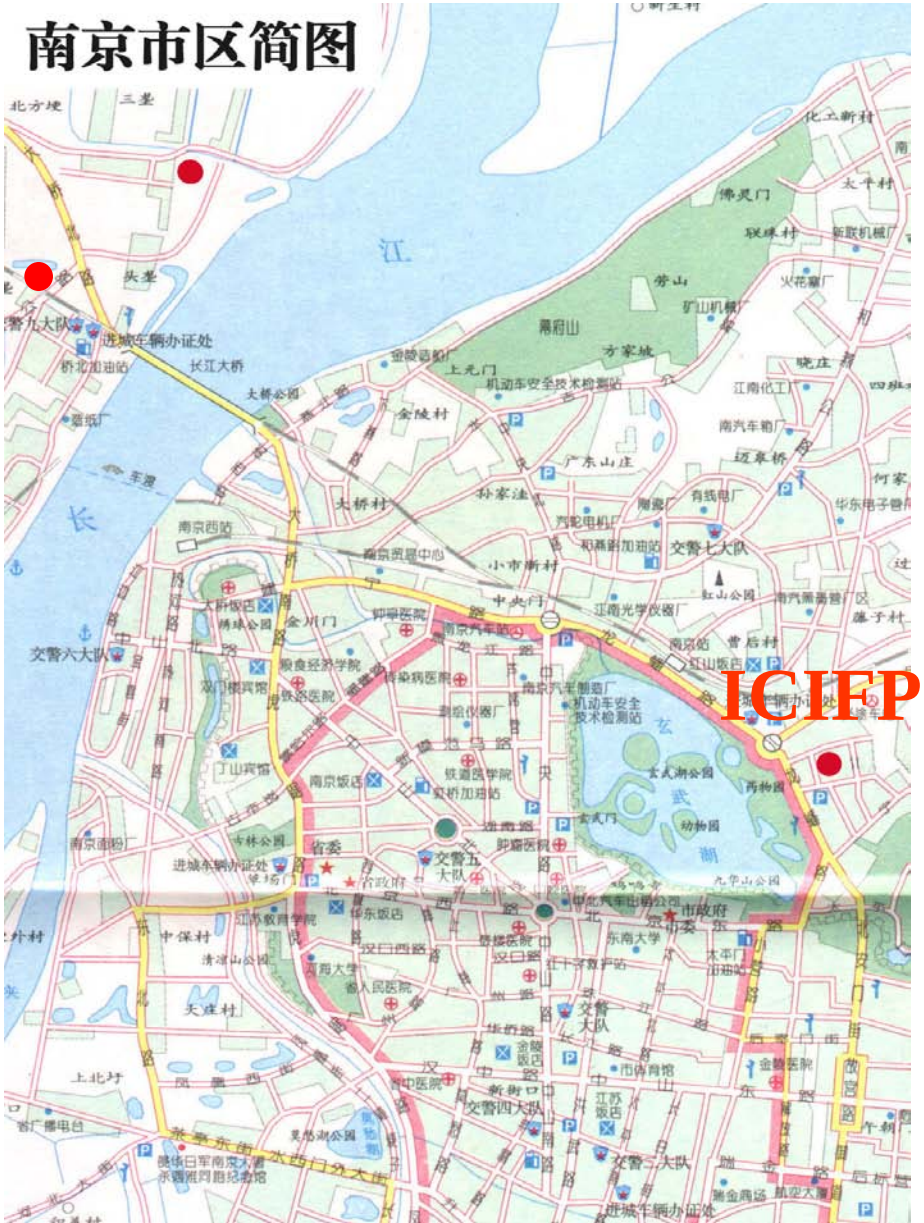
3. Current Research
   (Novel rosin-based monomer and its potential application)

4. Conclusion and Outlook

Brief Introduction of ICIFP

Institute of Chemical Industry of Forest Products (ICIFP)

location

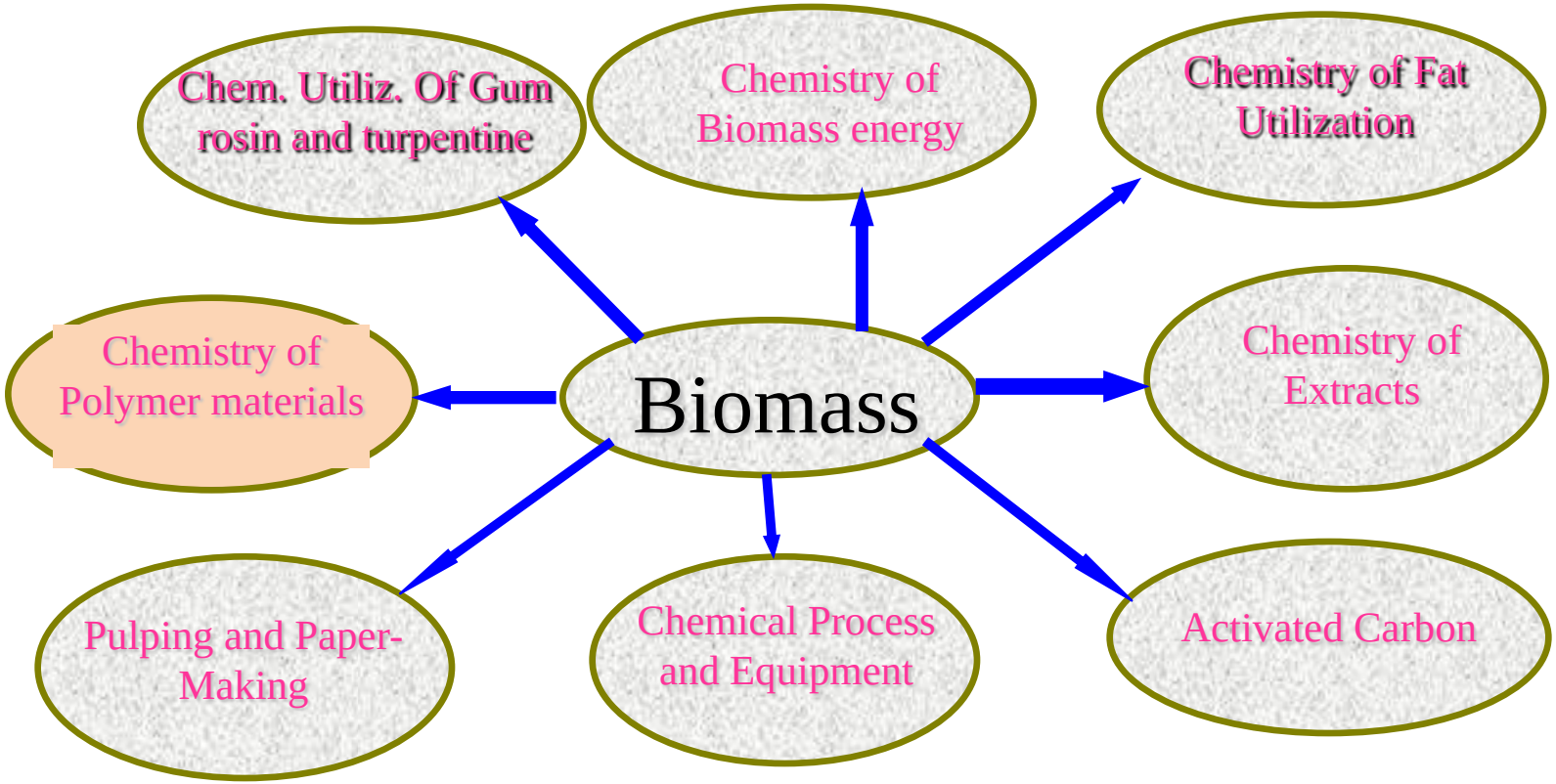


Brief Introduction of ICIFP

Institute of Chemical Industry of Forest Products (ICIFP),
Chinese Academy of Forestry（CAF）

Brief Introduction of ICIFP

Research Fields



There are 210 staff in the institute, including 18 research professors and 53 associate research professors and senior engineers.

Brief Introduction of ICIFP

Professor Zhan-Qian SONG

Academician of Chinese Academy of Engineering

chemical processing and utilization of biomass

Professor Fu-Xiang CHU

Academician of International Academy of Wood Science (IAWs)

Vice President of Chinese Academy of Forestry

Biomass polymer and emulsion polymerization

Professor Jian-Chun JIANG

Academician of International Academy of Wood Science (IAWs)

President of ICIFP

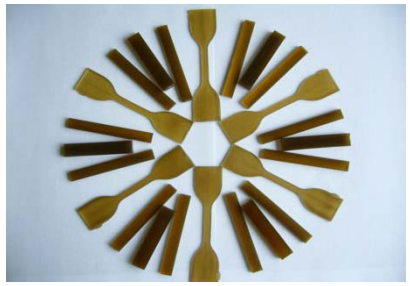
Biomass energy and activate carbon

Brief Introduction of ICIFP

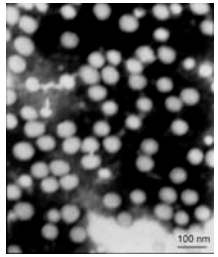
Research Interests:

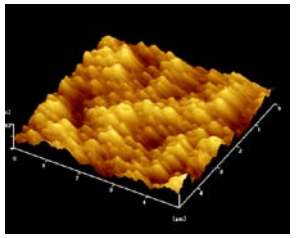
1 Biomass polymer materials
2 Acrylate Hybrid Latexes
3 Environmental friendly wood adhesives
4 Biomass based flame retardant foam

Professor Fu-Xiang CHU



Cellulose based degradable plastics





Polyurethane, Silicon, SiO_2, cellulose based latexes

Wood adhesives

Flame retardant foam

Background of Research

fiber

plastics

rubber

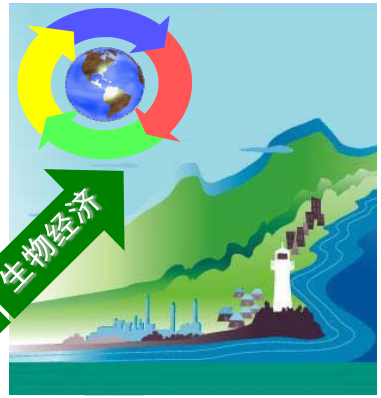
7 % fossil fuels

Environment

Energy

Source

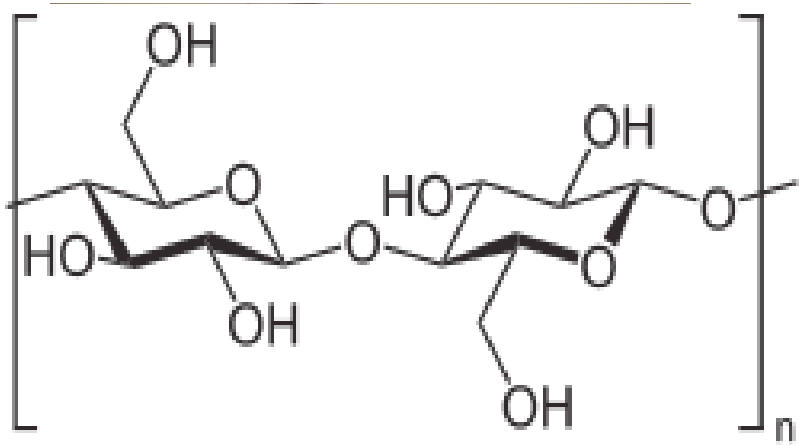
Sustainable development of the economy and society



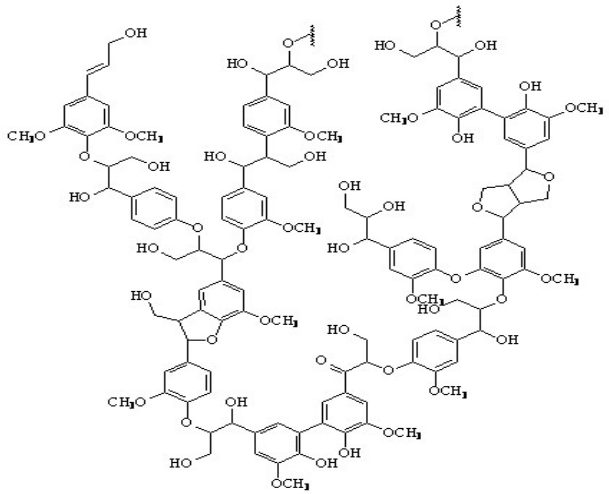
Background of Research

Polymers from Renewable Natural Resources

1) Natural polymers: cellulose, lignin, etc.



cellulose



lignin

2) Molecular biomass: vegetable oils, lactic acid, etc.
Molecularly engineered into renewable polymers

Background of Research

Motivation

❖Reductions of carbon footprint and dependence on fossil fuels as organic material feedstock.

❖Biodegradable polymers: biocompatibility and environmentally benign

❖Prepare the novel polymers by combination of natural biomass and synthetic polymers.

Background of Research

Rosin: Hydrocarbon Rich Renewable Biomass

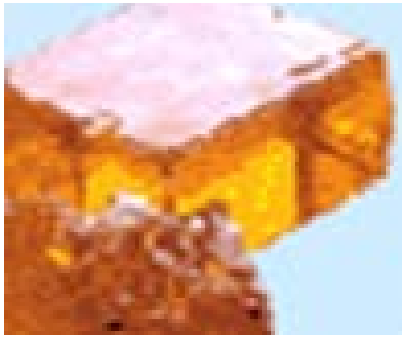
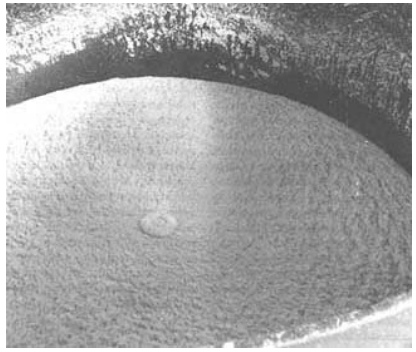
- Gum Rosin



- Wood Rosin



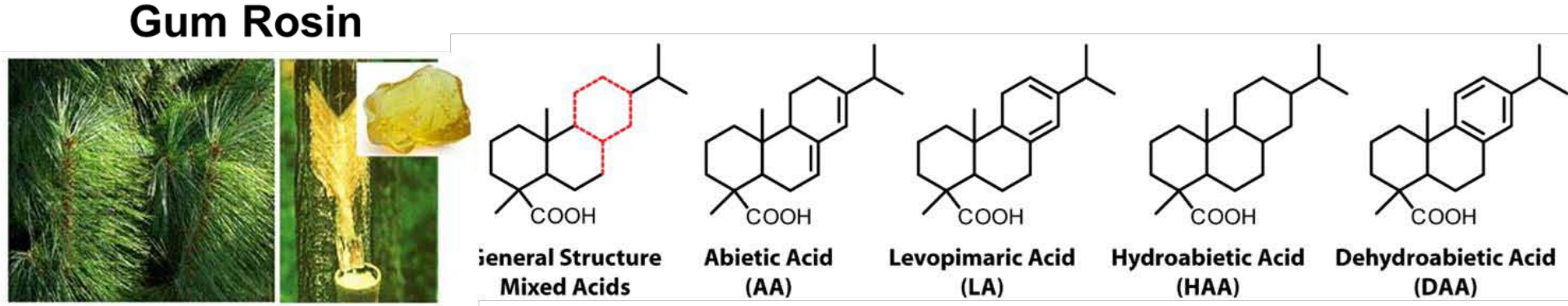
- Tall Rosin

Production: more than 1.0 million metric tons/year

Background of Research

Rosin: Hydrocarbon Rich Renewable Biomass



Functionalities: Carboxylic Acid and Conjugated Diene

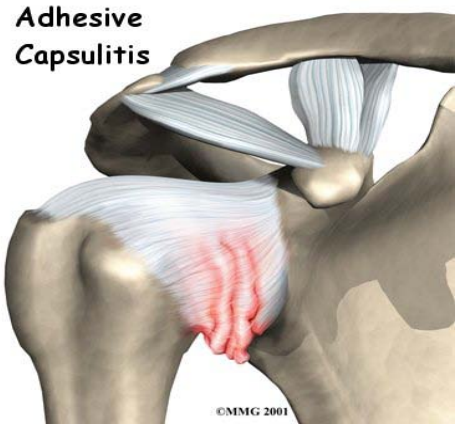
Unique properties :

- Hydrocarbon rich biomass: hydrophobicity
- Bulky hydrophenanthrene: thermal properties
- Biocompatible: rosin esters approved by US Food and Drug Administration (FDA) as food additives

Background of Research

Coatings

Ink



Adhesives

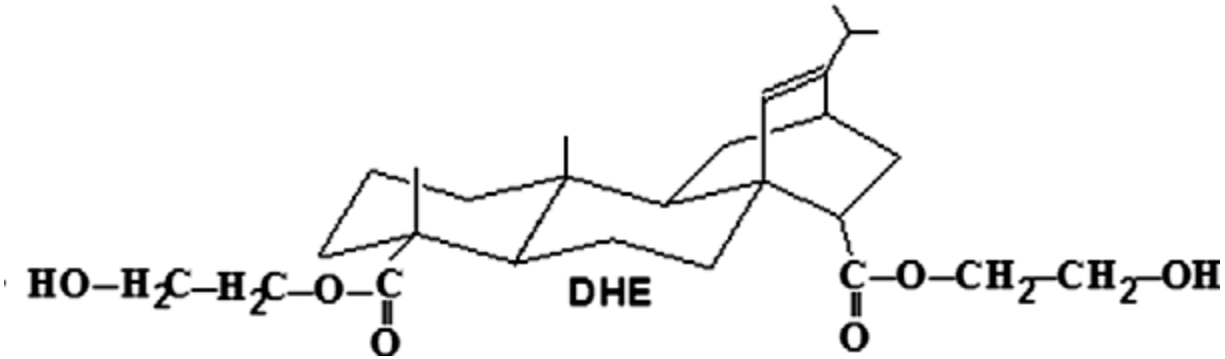
Booster flux

Chewing gum

Background of Research

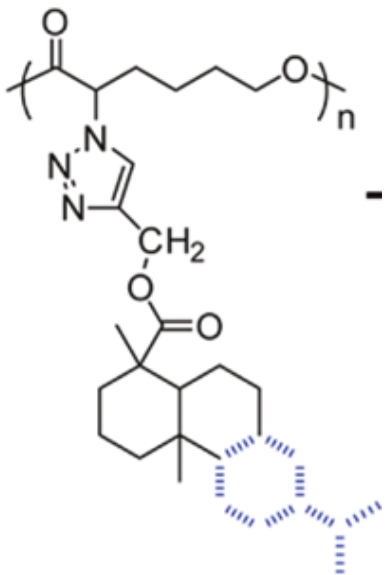
Application for the preparation of polymer

Main chain



Mustata, F.; Bicu, I. *Eur. Polym. J.* ***2010, 46, 1316.***

Side chain



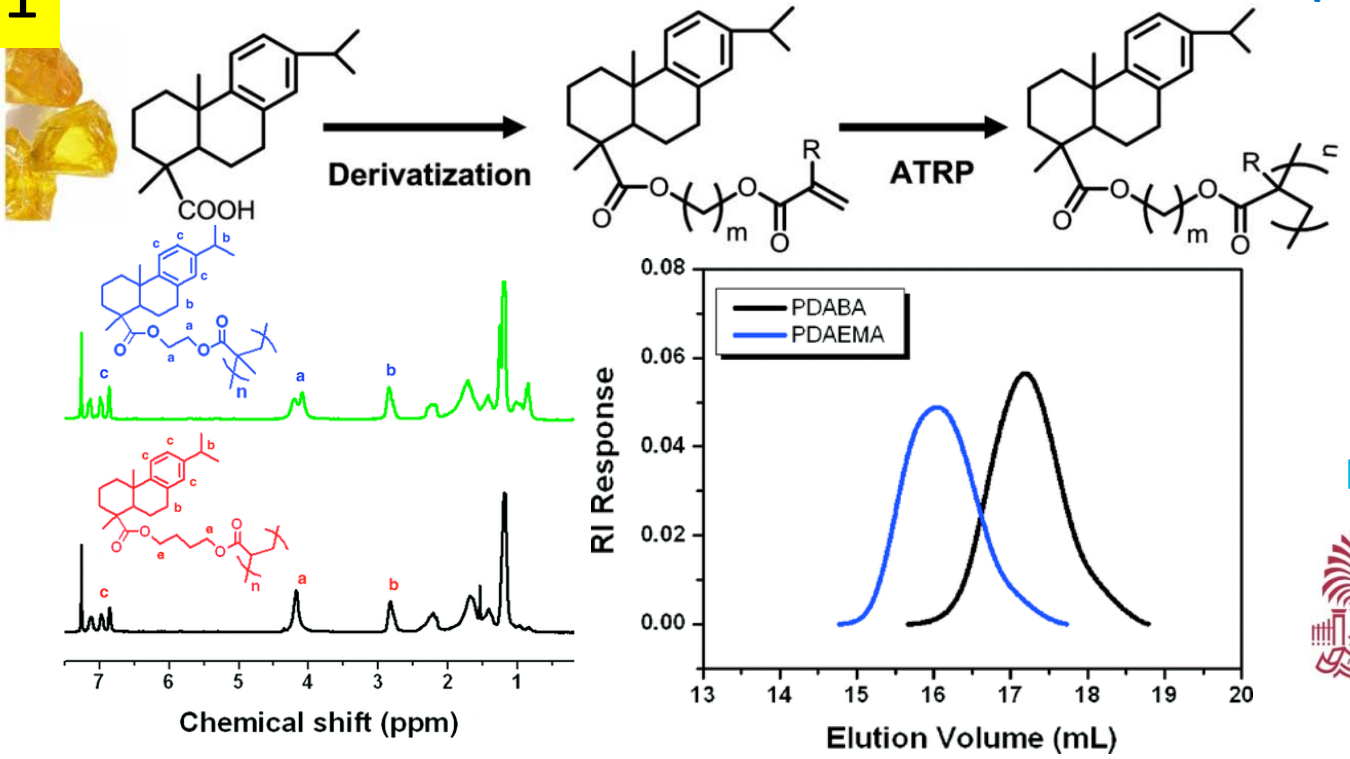
Yao, K.; Wang, J.; Zhang, W.; Lee, J. S.; Wang, C.; Chu, F.; He, X.; Tang, C. *Biomacromolecules* ***2011, 12, 2171.***

Past Research

1

Controlled living polymerization

Atom transfer radical polymerization(ATRP)



Professor Chuanbing Tang

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Zheng, Yao, Lee, Chandler, Wang, Wang, Chu, Tang, *Macromolecules,* 2010*, 43,* 5922-5924 **(IF=4.5)**

Past Research

2

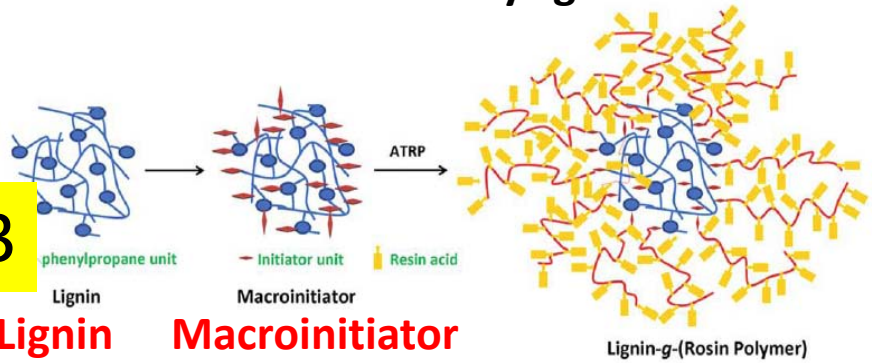
Wilbon, Zheng, Yao, Tang, *Macromolecules,* 2010, *43*, 8747-8754 **(IF=4.5)**

Past Research

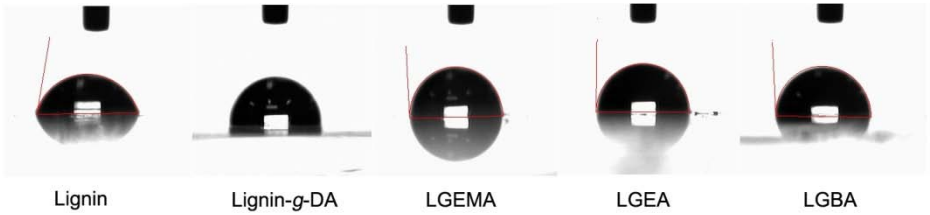
Combining renewable gum rosin and lignin

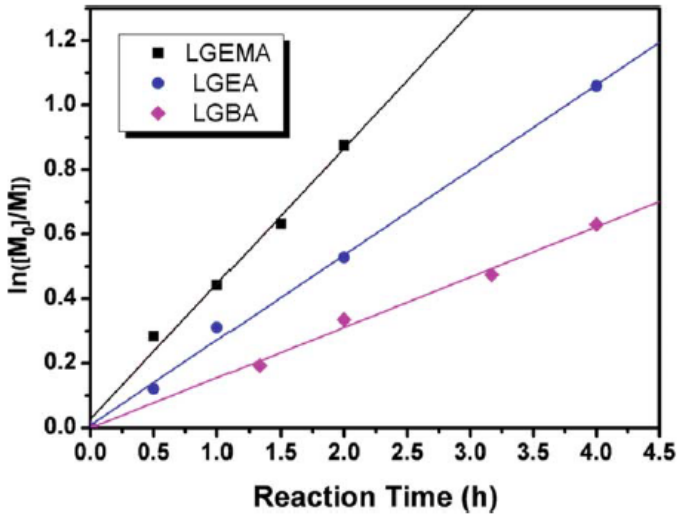
by "graft from" atom transfer radical polymerization(ATRP) .

3



Lignin **Macroinitiator**



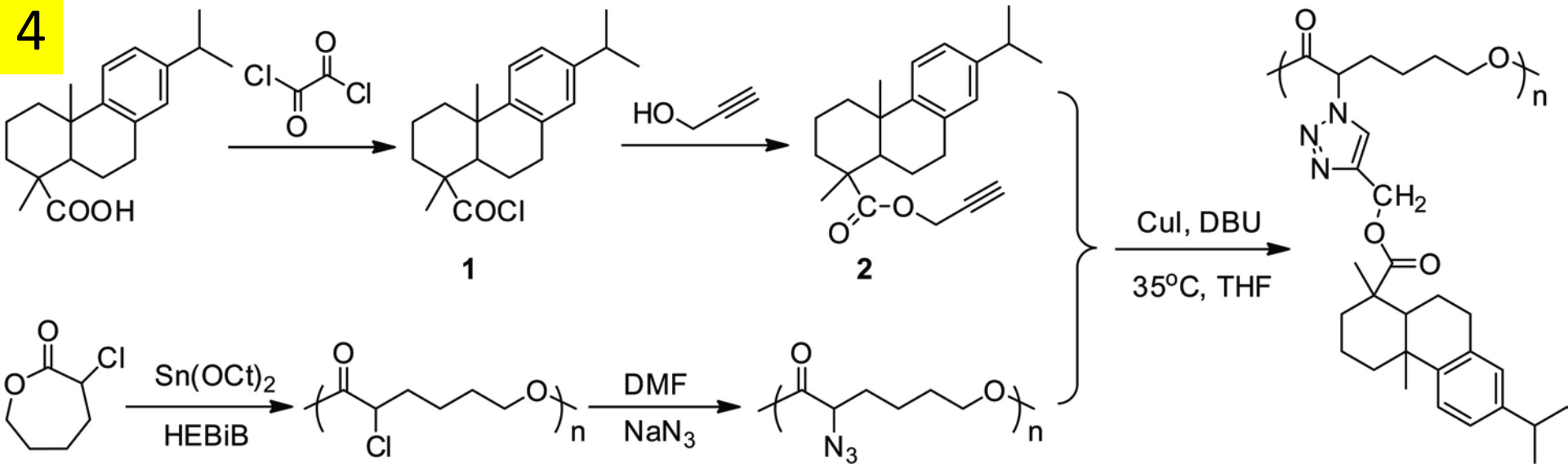


Wang, yao, Wang, Chu, Tang, *J. Polym. Sci. Polym. Chem.*, 2011, 49, 3728-3738 (**IF=3.89)**

Past Research

Synthesis of rosin ester-caprolactone graft copolymers

4



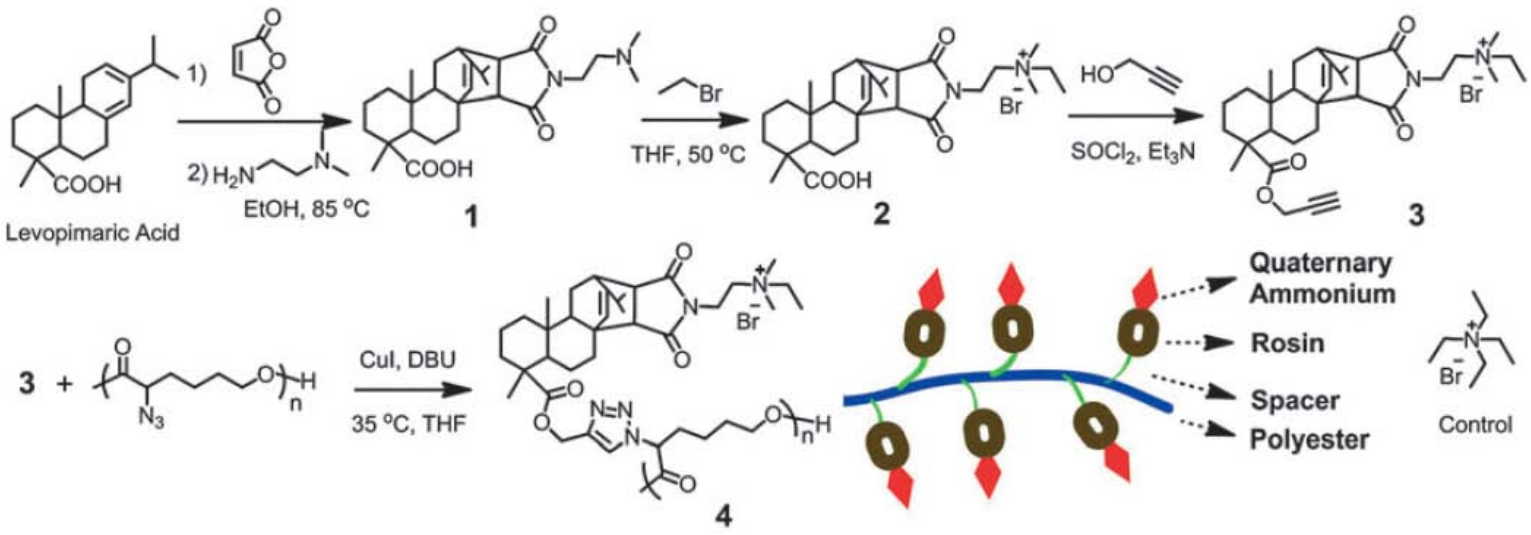
Ring opening polymerization and click chemistry

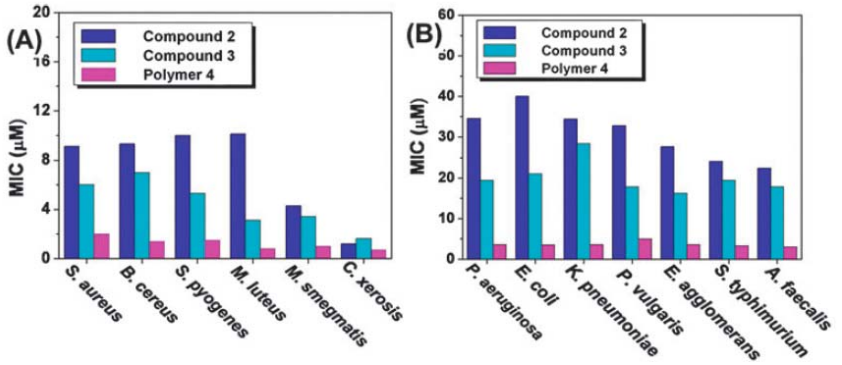
Yao, Wang, Zhang, Lee, Wang, Chu, He, Tang, *Biomacromolecules* , 2011, *12,* 2171-2177 **(IF=5.3)**

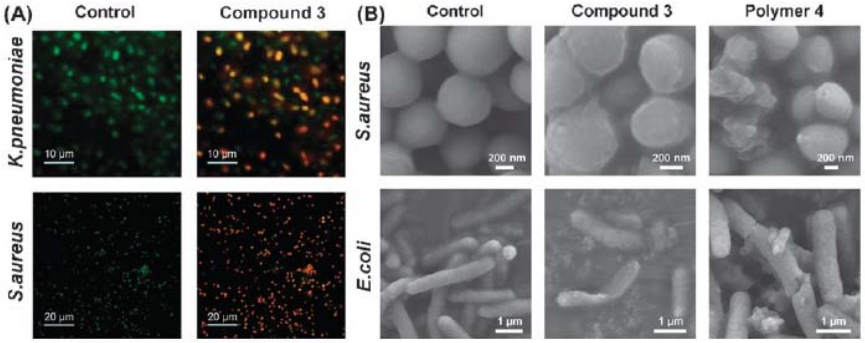
Past Research

Robust Antimicrobial Compounds and Polymers Derived from Natural Resin Acids

5





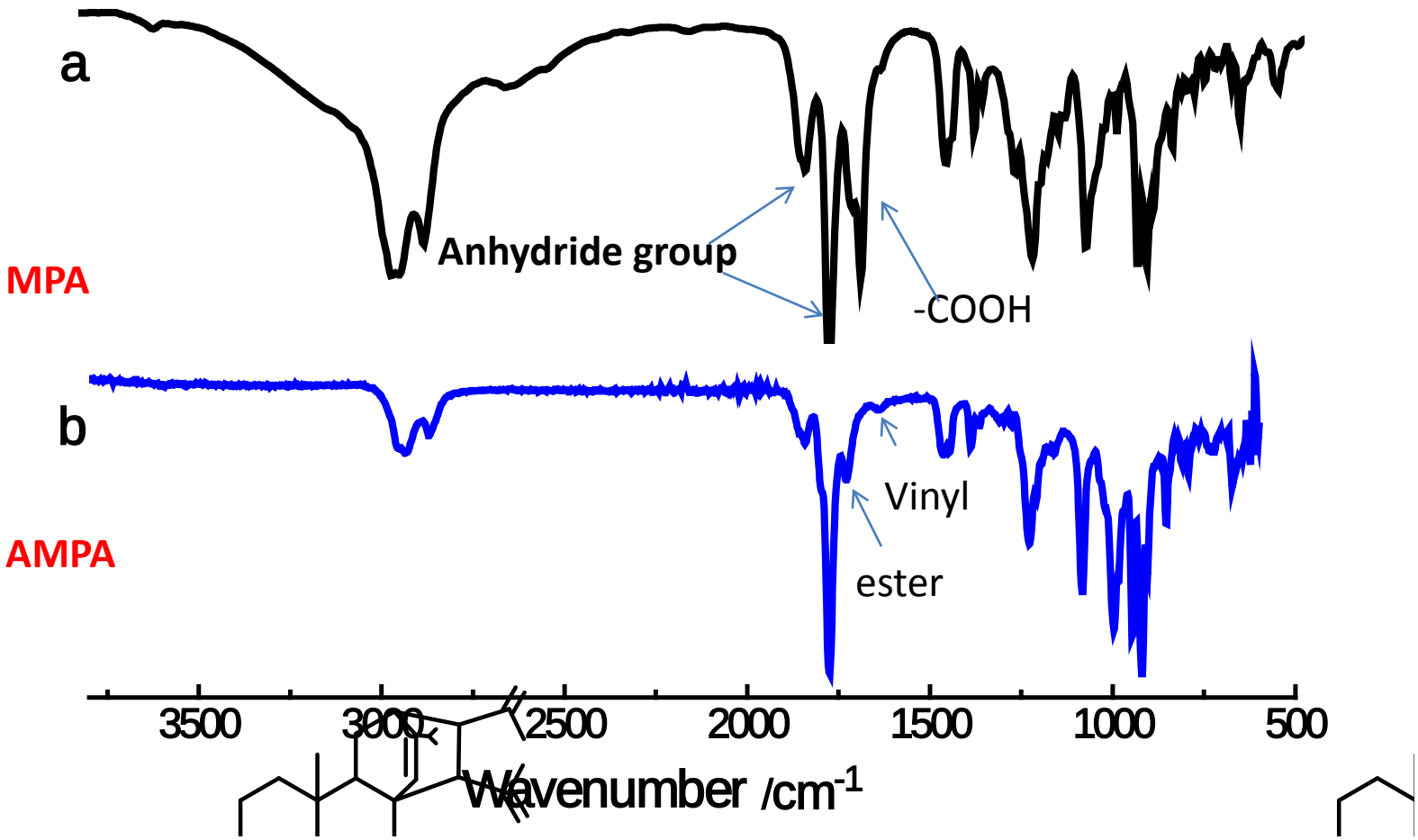


Wang, J.; Chen, Y. P.; Yao, Wang, C.; Chu, F.;, tang,C. et,al. *Chem Commun 2012, 48, 916.* ***(IF=6.17)***

Current Research

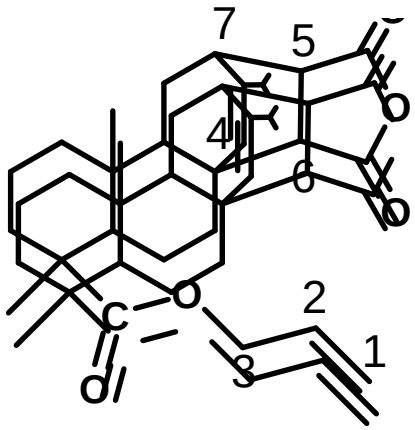
Synthetic strategy

Current Research



Current Research

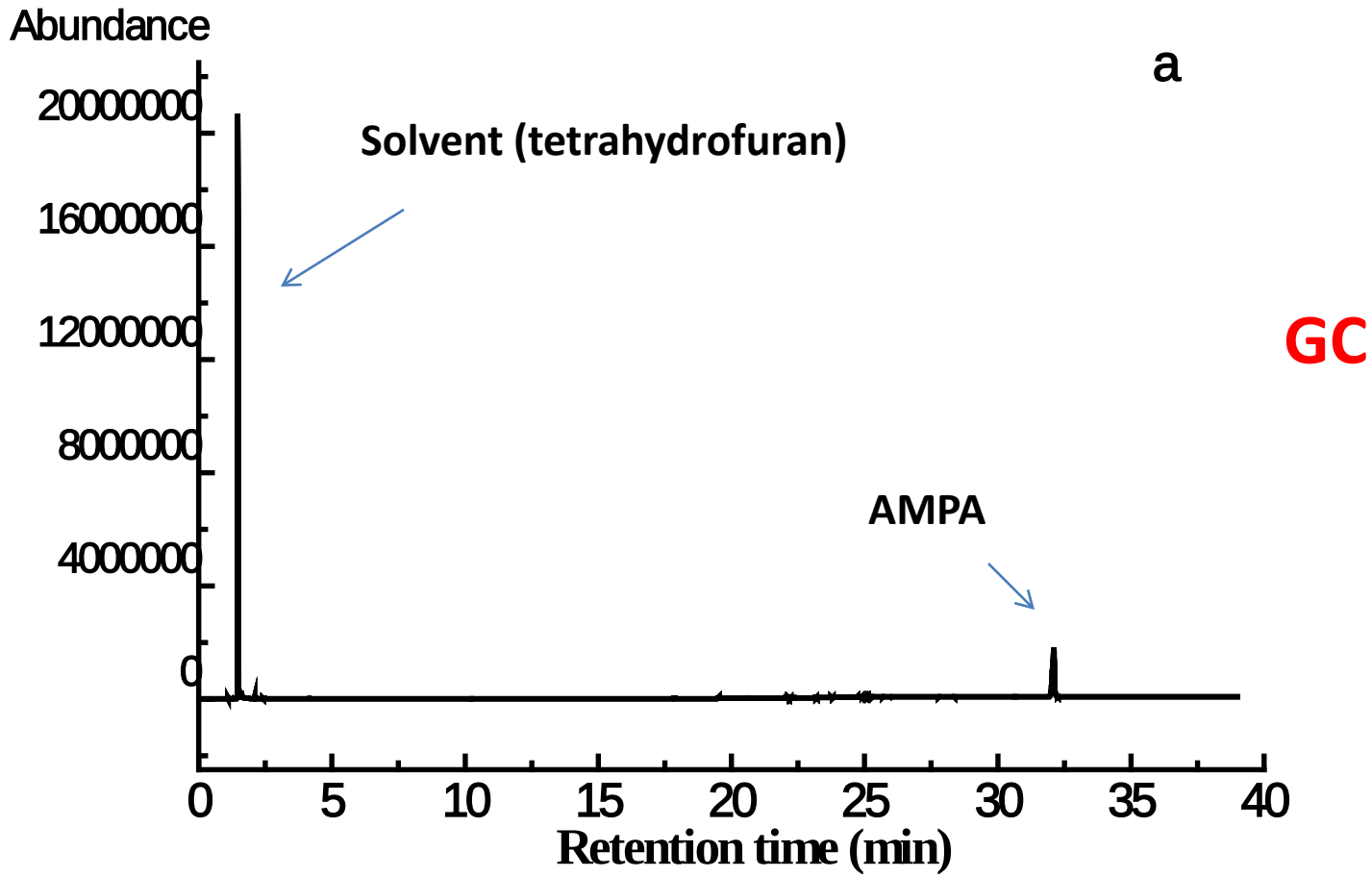
Proton NMR(^{1}H NMR)



AMPA

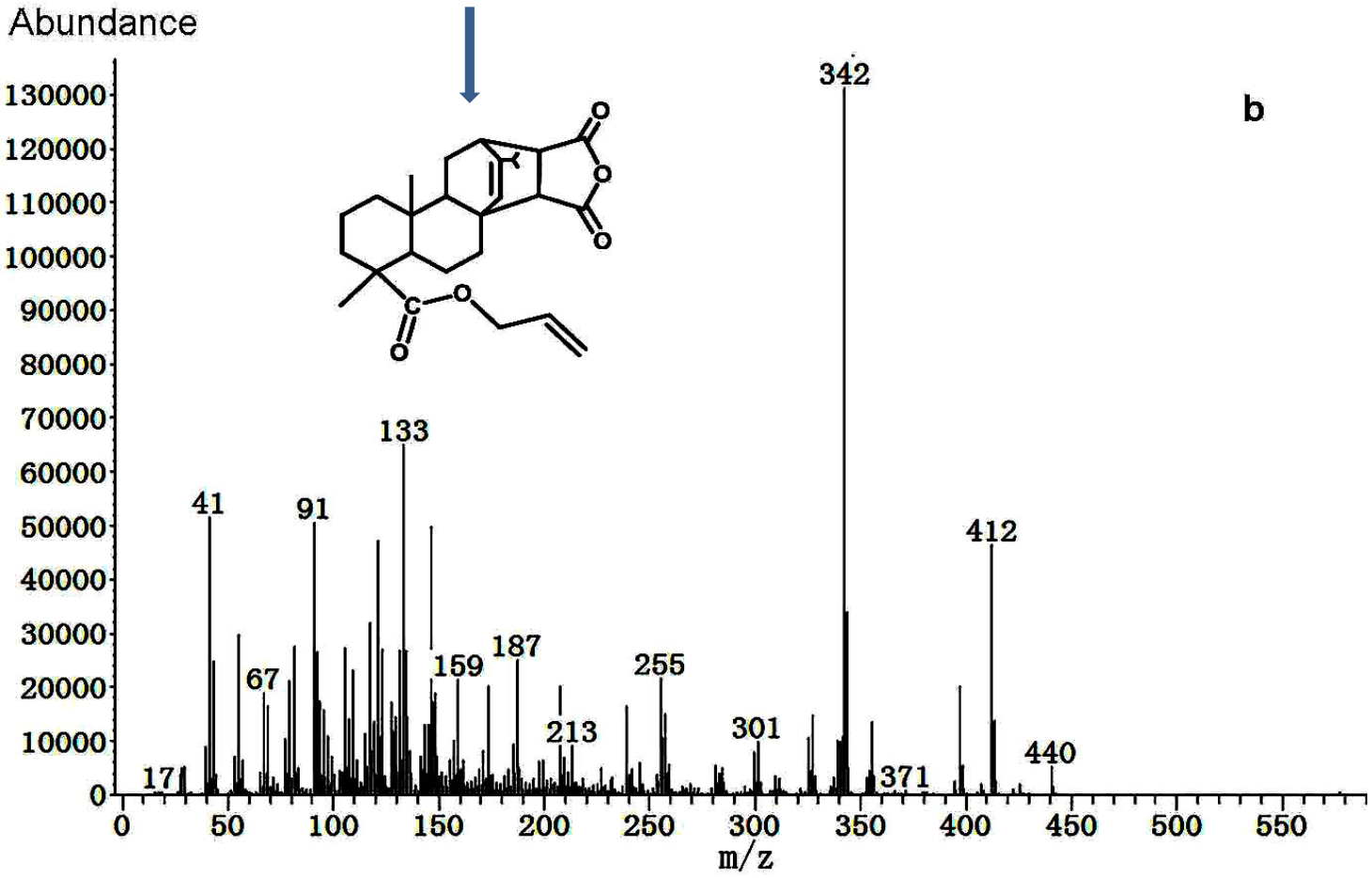
Current Research

Gas chromatography–mass spectrometry (*GC-MS*)



Current Research

Theoretical molecular weight=440



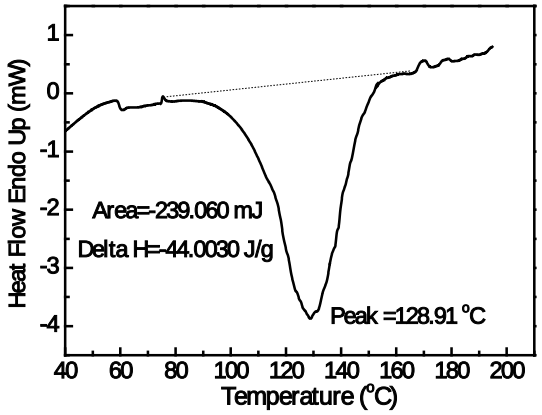
Current Research

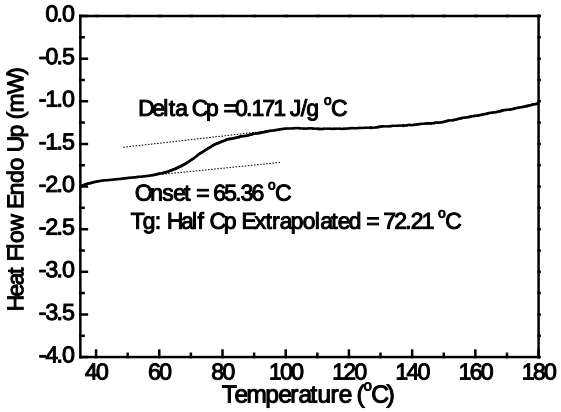
Free radical polymerization of AMPA

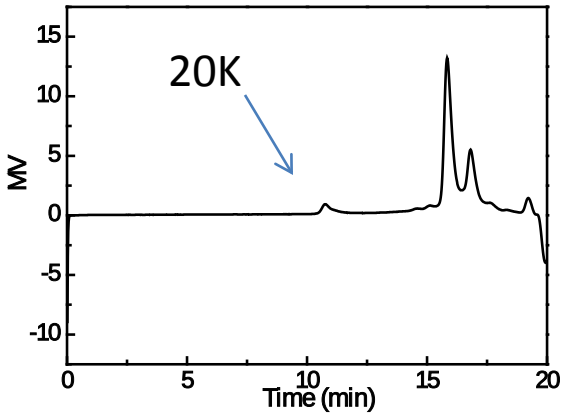
AMPA + **Free radical initiator**

Bulk free radical polymerization

Differential scanning calorimetry (DSC)







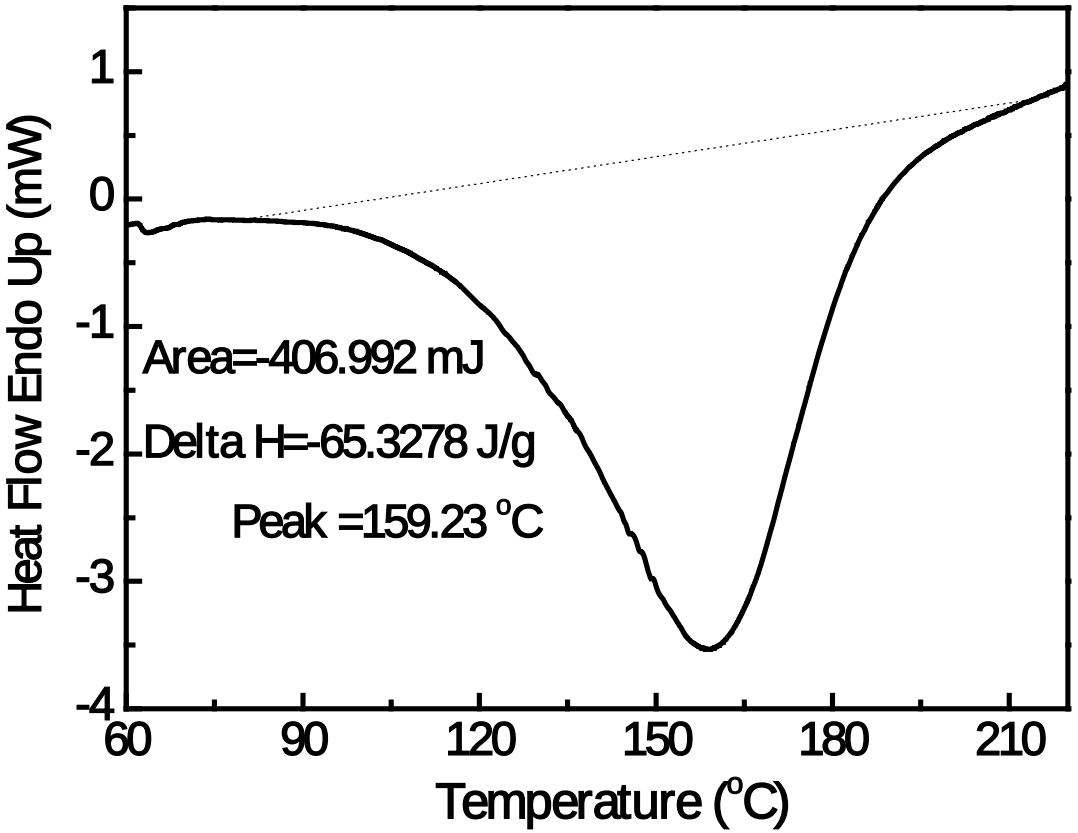
GPC Results

	Dist Name	Elution Volume (ml)	Retention Time (min)	Adjusted RT (min)	Mn	Mw	MP	Mz	Mz+1	Mz/Mw
1		10.756	10.756	10.756	16749	18210	20284	19547	20778	1.073439

Current Research

DSC thermograms of cured AMPA/epoxy resin at ratio:1/1

DSC



Conclusion and Outlook

❖ Rosin based monomer is a high purity monomer

❖ Free radical polymerization for preparation of side chain rosin based polymer with anhydride group

❖ Curing agent for epoxy resin

❖ Applications for thermoset resin.

✧Curing and cure kinetics

✧Amphiphilic block copolymer and self-assembly

Acknowledgement

Innovation team for the research of biomass–based polymer composite

Chinese Academy of Forestry

UNIVERSITY OF SOUTH CAROLINA

Professor Fu-Xiang CHU

Professor Chuanbing Tang

国家国际科技合作专项
International S&T Cooperation Program of China (ISTCP)
国际科技合作 International S&T Cooperation

(2011DFA32440)

Thank you for your attention

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