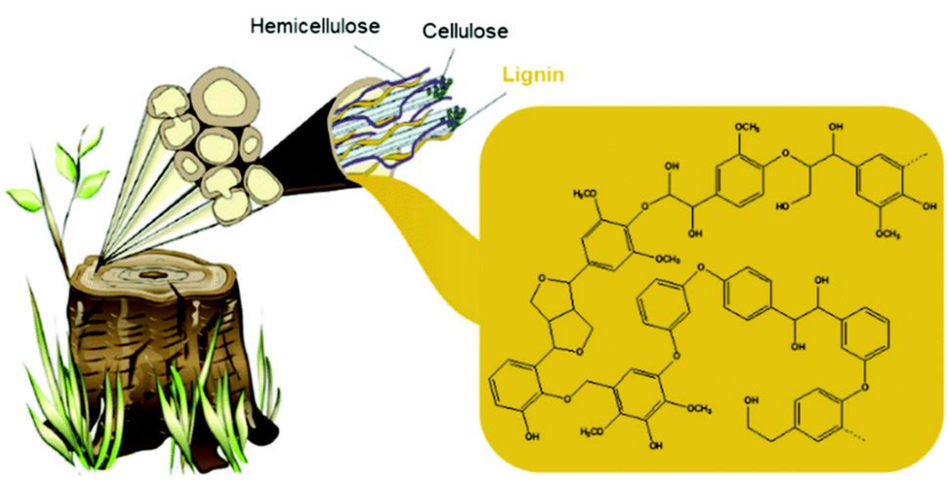
Scalable, tunable and monodisperse eco-friendly lignin nanoparticles

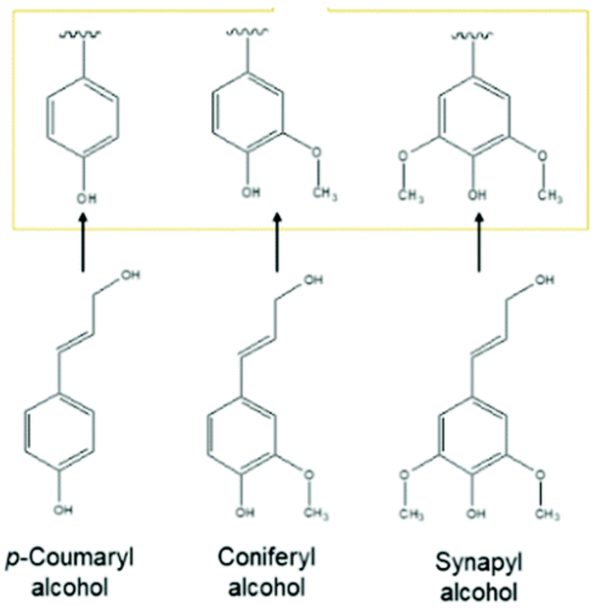
Vasileios Tsampallas[1,2], **Maria Kaliva [1,2]**, Anastaisa Tzerainidi[1,2], Evangelia Vassilaki[1,2,3], Min Ge[3], Svitlana Filonenko[3], George Petekidis[1,2], Markus Antonietti[3], Maria Vamvakaki[1,2]

[1]Institute of Electronic Structure and Laser, FORTH, Heraklion, Crete, Greece
[2]Department of Materials Science and Engineering, University of Crete, Heraklion, Crete, Greece
[3]Max-Planck Institute of Colloids and Interfaces, Department of Colloid Chemistry, Potsdam, Germany

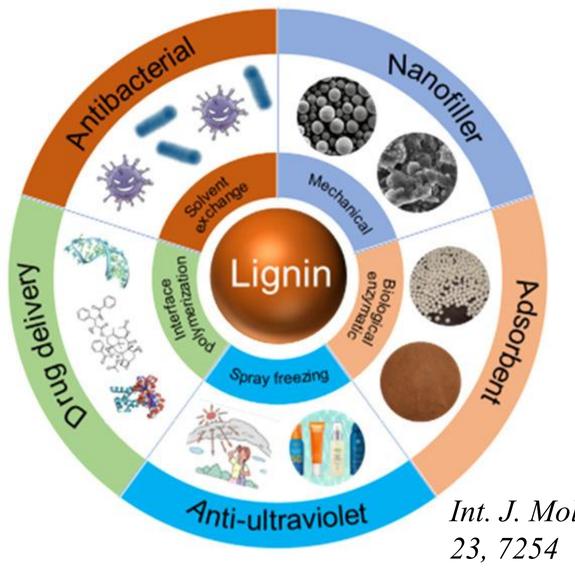
Lignin



New J. Chem. 2021, 45, 6986-7013.



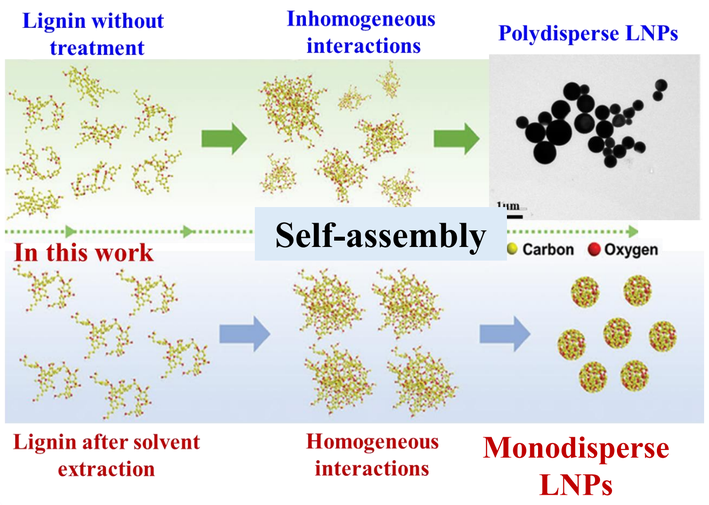
Applications of Lignin NPs



Int. J. Mol. Sci. 2022, 23, 7254

Aim of the Work

Conventional methods



Small **2022**, *18*, 2200671

Preparation of monodisperse lignin nanoparticles (LNPs) by lignin fractionation

+

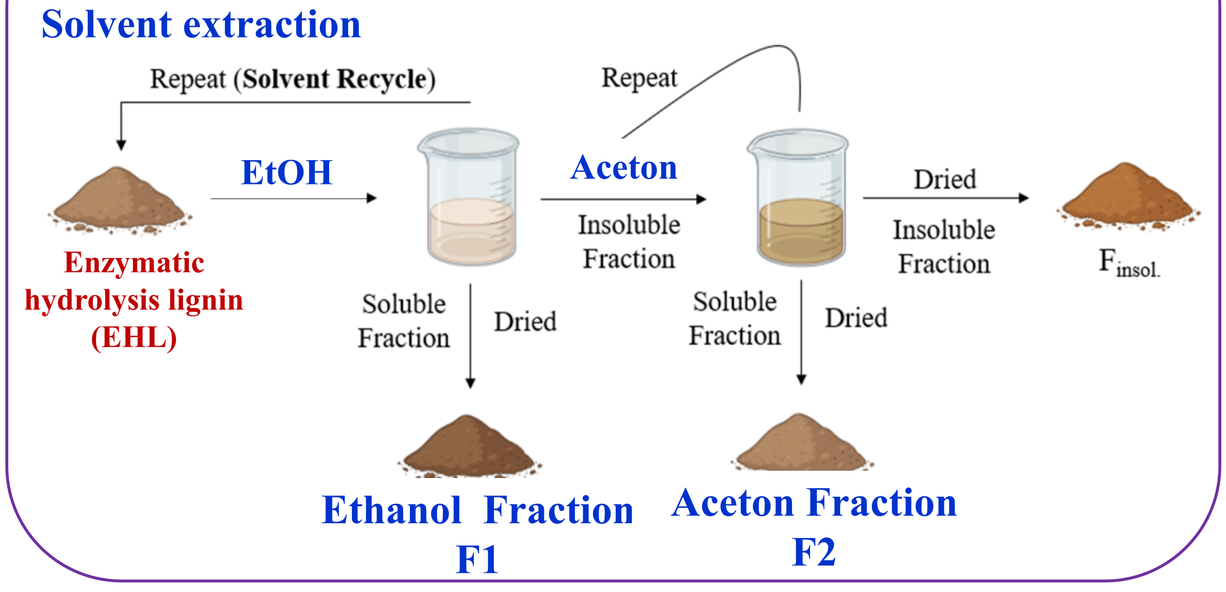
Molecular and chemical characterization of lignin Fractions

+

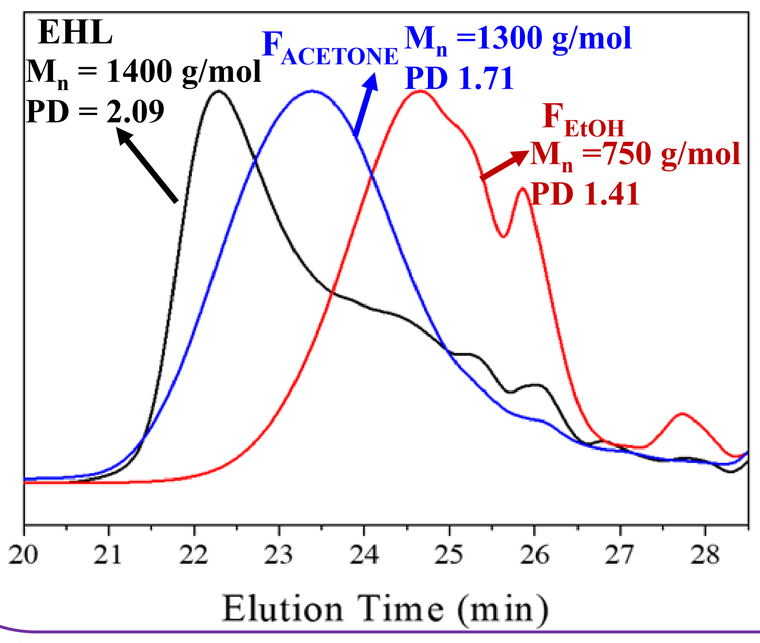
Size Tuning of LNPs

Step 1: Fractionation of Lignin

Solvent extraction

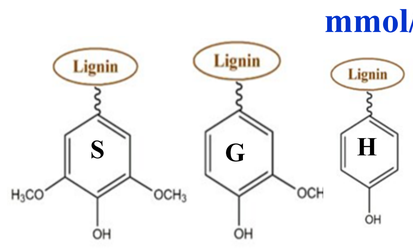


Molecular and Chemical Characterization of the EHL Fractions



Functional groups content

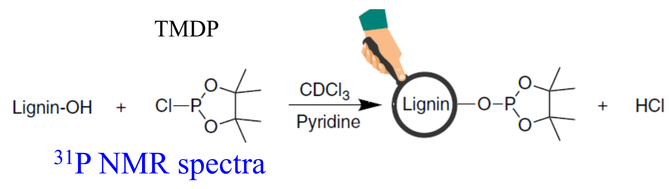
mmol/g



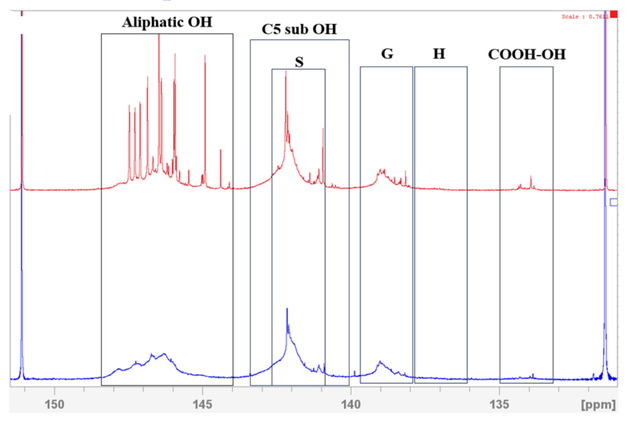
	Phenolic-OH	Aliphatic OH	COOH	Total OH+COOH
$F_{ACETONE}$	1.76	0.47	0.015	2.23	1.72	0.04	**3.99**
F_{EtOH}	2.28	0.68	0.012	2.96	3.03	0.05	**6.04**

$F_{ACETONE}$: most hydrophobic fraction

TMDP

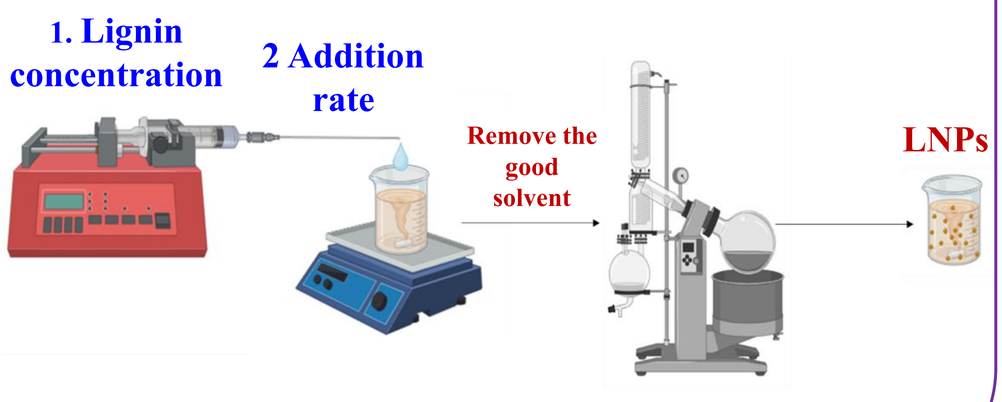


^{31}P NMR spectra



Step 2: Formation of Lignin NPs

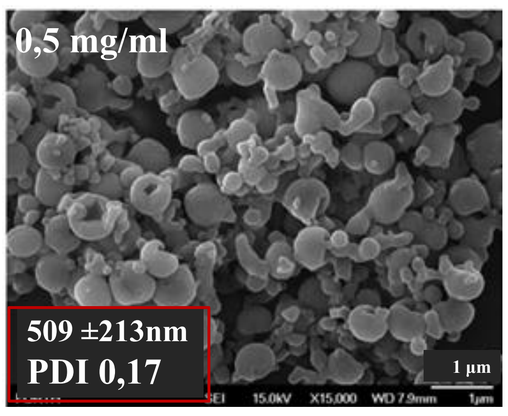
Solvent/Antisolvent Self Assembly



Monodisperse NPs using $F_{ACETONE}$

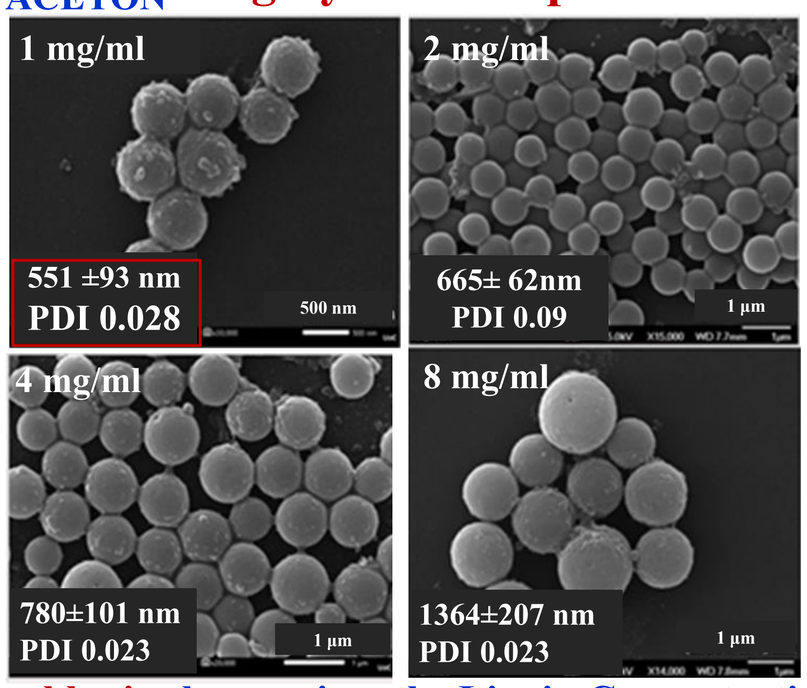
Addition rate 0,62ml/min

F_{EtOH}



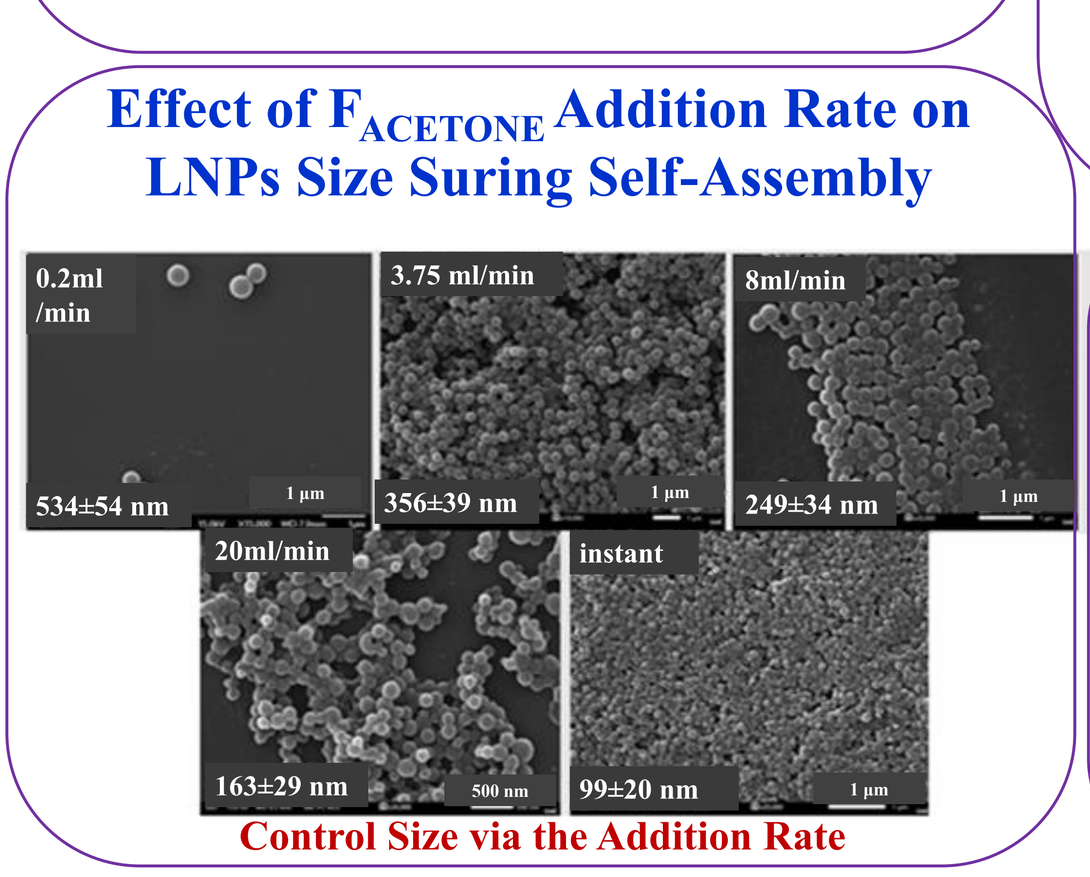
Polydisperse LNPS

F_{ACETON} :Highly monodisperse LNPS



Tunable size by varying the Lignin Concentration

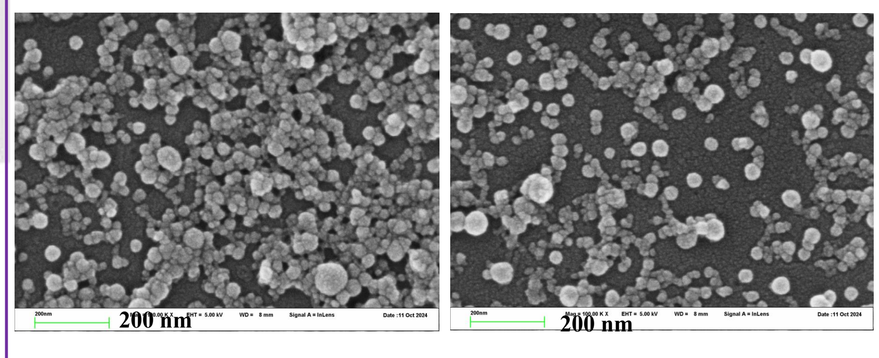
Effect of $F_{ACETONE}$ Addition Rate on LNPs Size Suring Self-Assembly



Control Size via the Addition Rate

Synthesis of Bamboo Lignin NPs

Diameter 40 ± 30 nm



Particles obtained without fractionation

Small, yet polydisperse NPs

Acknowledgments

The research project was financed by the *EU HORIZON-WIDERA-2021-ACCESS-03-01-Twinning project "Advancing Research & Innovation of FORTH in Green Soft Matter" FORGREENSOFT*, (GA No: 101078989).

Comisión Europea