GROUP OF POLYMERS

CHALLENGES AND OPPORTUNITIES OF 3D-PRINTED LIGNIN-BASED PHOTOCURABLE COMPOSITES: FROM WASTE TO HIGH VALUE APPLICATIONS

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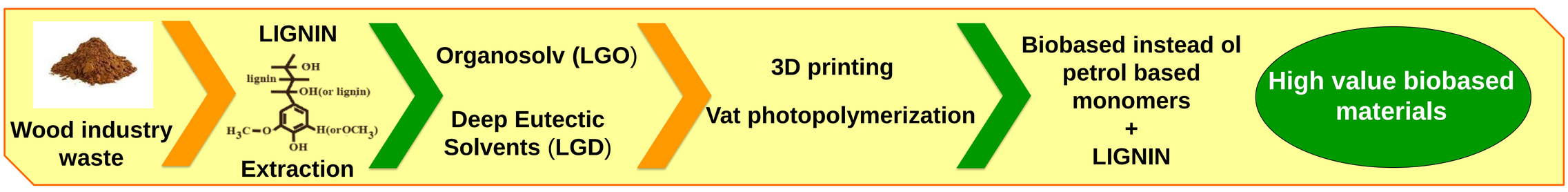
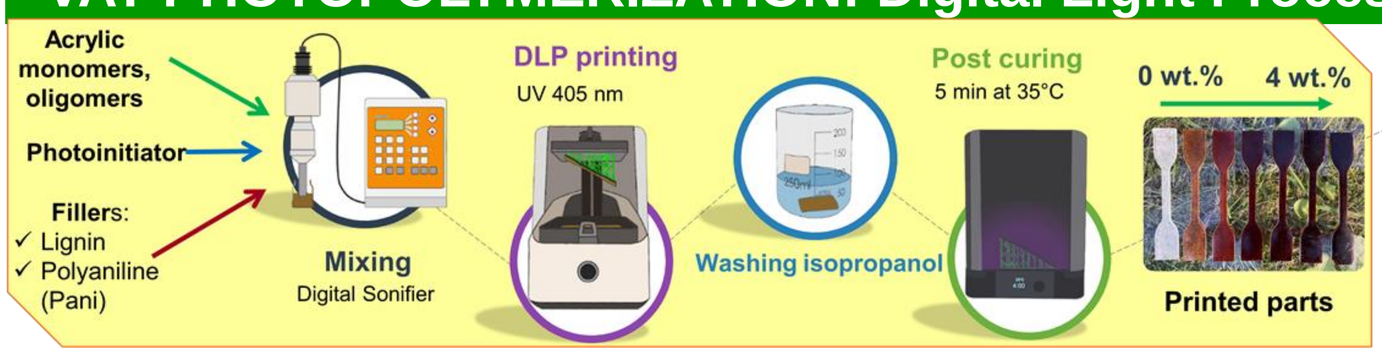
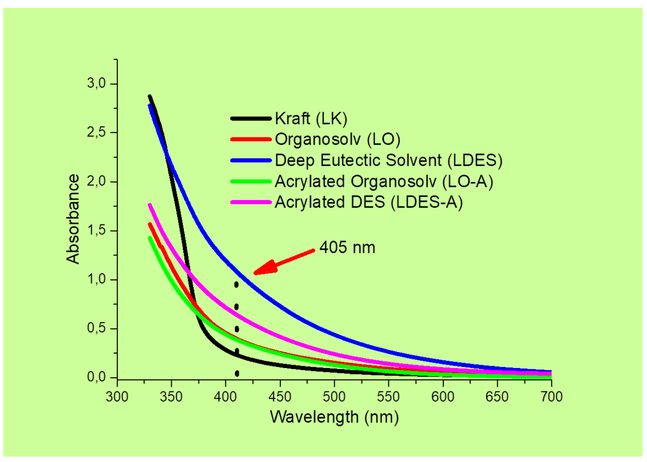


VAT PHOTOPOLYMERIZATION: Digital Light Processing (DLP)



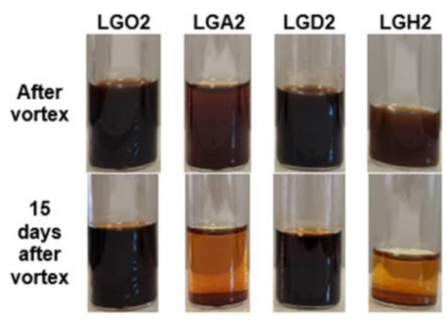
CHARACTERIZATION:
Jacobs working curves, rheology, FTIR, mechanical thermal properties, electrical performance, microscopy…

UV- Absorption in THF



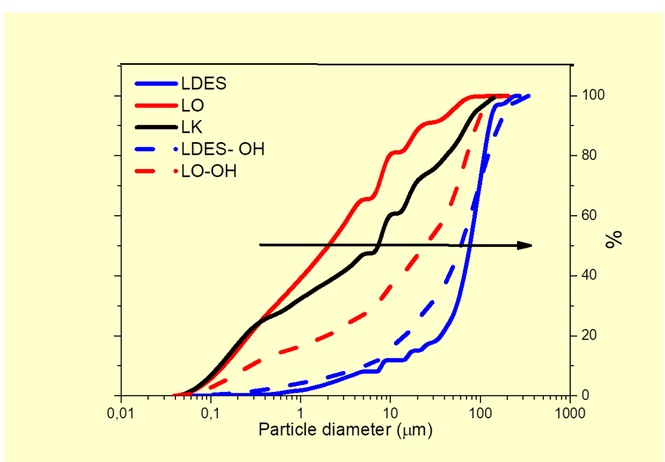
LONGER PRINTING TIMES !!!!

Compatibility with Monomers



Sedimentation test of different types of lignin in the bioresin B=PEGDMA200/C10DA 50/50 [1]

Particle Size Distribution



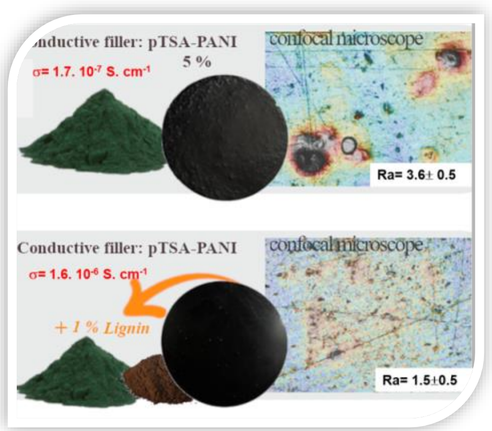
AGGREGATION !!!

LIGNIN CHEMICAL MODIFICATION, ↑ ULTRASONICATION TIME, SELECTION OF ADEQUATE LIGNIN-MATRIX PAIR

BENEFITS and POTENTIAL APPLICATIONS – 3D PRINTED MATERIALS

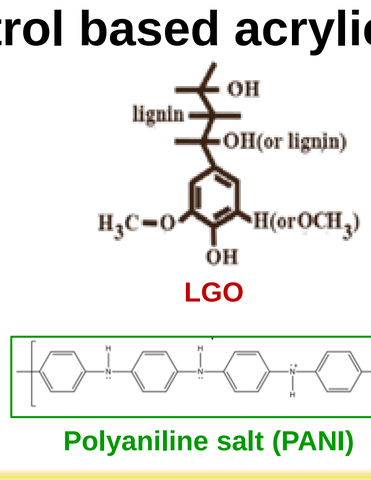
Unmodified lignin

✓Compatibilizer



1 wt.% LGO improved dispersion, surface smoothness, ↑ wettability and ↑ electrical conductivity of 5 wt.% PANI-PTSA by one order of magnitude [2]

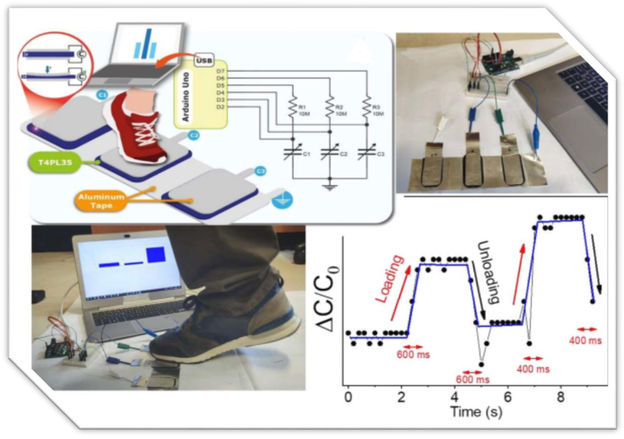
Petrol based acrylic resin



Biobased acrylic resin (B)

Chemically modified lignin

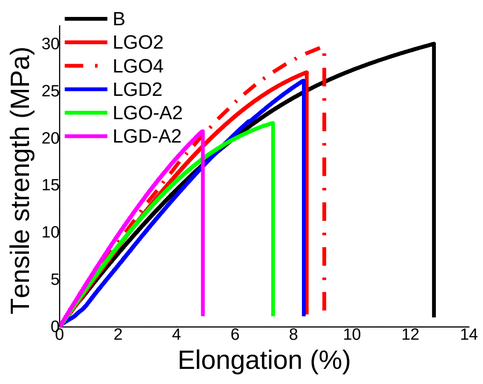
✓Printable Electronics



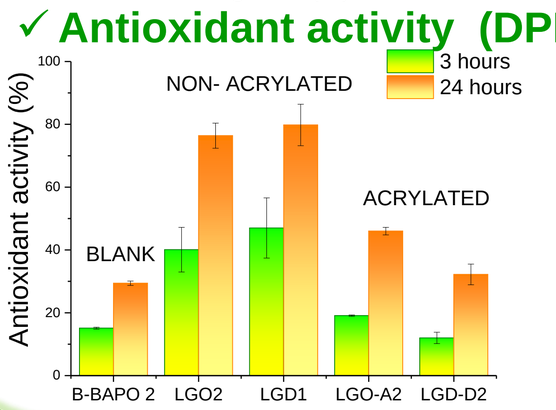
Proof of concept of a capacitive sensor developed with polyaniline-lignin as conductive filler. Reproduced from [3]

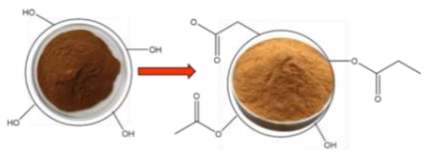
Organosolv (LGO) and DES Non-acrylated lignin (LGD) vs Acrylated (LGO-A, LGD-A)

✓ Non-acrylated better tensile properties

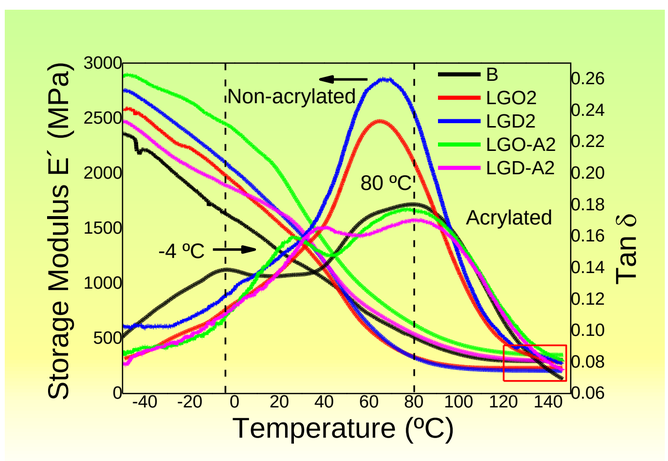


✓ Antioxidant activity (DPPH)





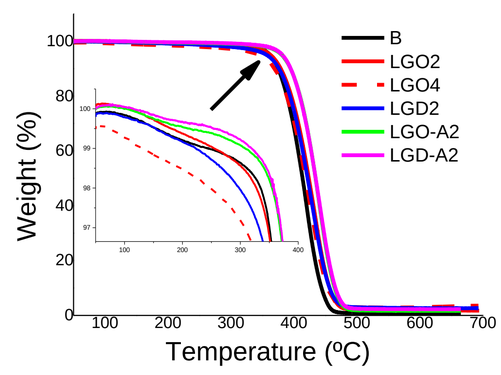
Acrylation ↓ absorptivity, ↓ printing times



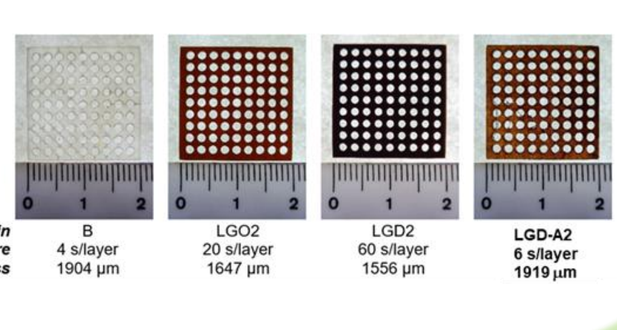
✓ **Acrylation ↑ crosslinking density and the modulus above T_g. Non-acrylated lignin ↓ T_g.**

✓ **The higher damping at the transition for non-acrylated composites is due to lower crosslinking density.**

✓ Acrylation ↑ Thermal stability



✓ All types ↑ Printing accuracy



CONCLUSIONS

- ✓ **Bio-based 3D printed resins developed from waste products maintain properties comparable to petroleum-based materials, with potential applications in printable electronics and other fields.**
- ✓ **The choice of lignin type depends on its compatibility with the photopolymerizable resin, the desired enhanced properties, and the sought-after cost-effectiveness.**
- ✓ **More bio-based photocurable monomers needed to expand commercial portfolio.**

ACKNOWLEDGEMENTS

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[2] G. Arias-Ferreiro et al. (2022). Polymers 2022,14(19),4164; DOI:10.3390/polym14194164[2]

[3] G. Arias-Ferreiro et al. (2022). *Advanced Materials Technologies*, *7*(8) DOI:10.1002/admt.202101503

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