



## HYBRID EMULSIFIER SYSTEMS IN STYRENE POLYMERIZATION: ROLE OF LIGNIN IN LATEX STRUCTURE AND PROPERTIES

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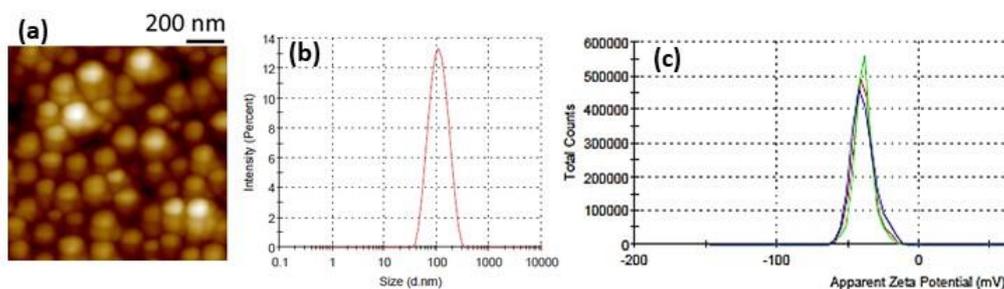
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This study investigated the use of the water-soluble fraction of lignin (lig) as a co-emulsifier in batch emulsion polymerization of styrene, using (azobisisobutyronitrile, AIBN) as initiator. Lig at 0.5 g/L, sodium dodecyl sulfate (SDS) at 10 mM, and lig/SDS at the 0.25 g/L/5 mM ratio presented surface tension values of  $53.50 \pm 0.90$  mN/m,  $35.13 \pm 0.09$  mN/m, and  $28.83 \pm 0.31$  mN/m, respectively, suggesting lig as a potential co-emulsifier. For 0.7 g/L of AIBN, the conversion rates (%) of monomer into polymer using SDS/lig were lower ( $24 \pm 1\%$ ) than those using pure SDS ( $40 \pm 5\%$ ). Upon increasing AIBN content, the presence of lignin reduced dramatically the conversion compared to SDS-only systems, suggesting that lignin acts as a radical scavenger<sup>1,2</sup>. Notably, the SDS/lig formulation with 0.7 g/L of AIBN yielded spherical polymer particles with a mean diameter of  $100 \pm 7$  nm, PDI  $0.23 \pm 0.03$ , and a zeta potential of  $-(36 \pm 2)$  mV, as shown in Figure 1. Differential scanning calorimetry (DSC) revealed a single glass transition ( $T_g$ ) at  $76.2$  °C, and a distinct melting transition ( $T_m$ ) at  $112.8$  °C, suggesting the possible formation of a novel semicrystalline structure. Pure lig presented  $T_g$  at  $73.7$  °C. Thermogravimetric analysis (TGA) revealed that beyond the degradation process of lig and polystyrene, another event appeared at  $\sim 204$  °C. Kraft lignin contains components that might carry thiol group and can react with styrene via thiol-ene click reaction<sup>3</sup>, yielding a new polymer structure. The chemical composition of lig and the resulting polymer is under investigation. While lig cannot fully replace SDS as emulsifier, these preliminary results showed that the SDS/lig yielded latexes with distinct thermal properties and potential UV resistance<sup>4</sup>, owing to the intrinsic characteristics of lignin.



**Figure 1** – (a) AFM topographic image, (b) mean particle size, and (c) zeta potential obtained for PS synthesized with SDS/lig and 0.7 g/L AIBN.

### References

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