POLYMAT

Universidad del País Vasco / Euskal Herriko Unibertsitatea

EFFECT OF SHEAR ON THE ELECTRICAL PROPERTIES OF POLYBUTILENE SUCCINATE-CO-ADIPATE/MWCNT NANOCOMPOSITES

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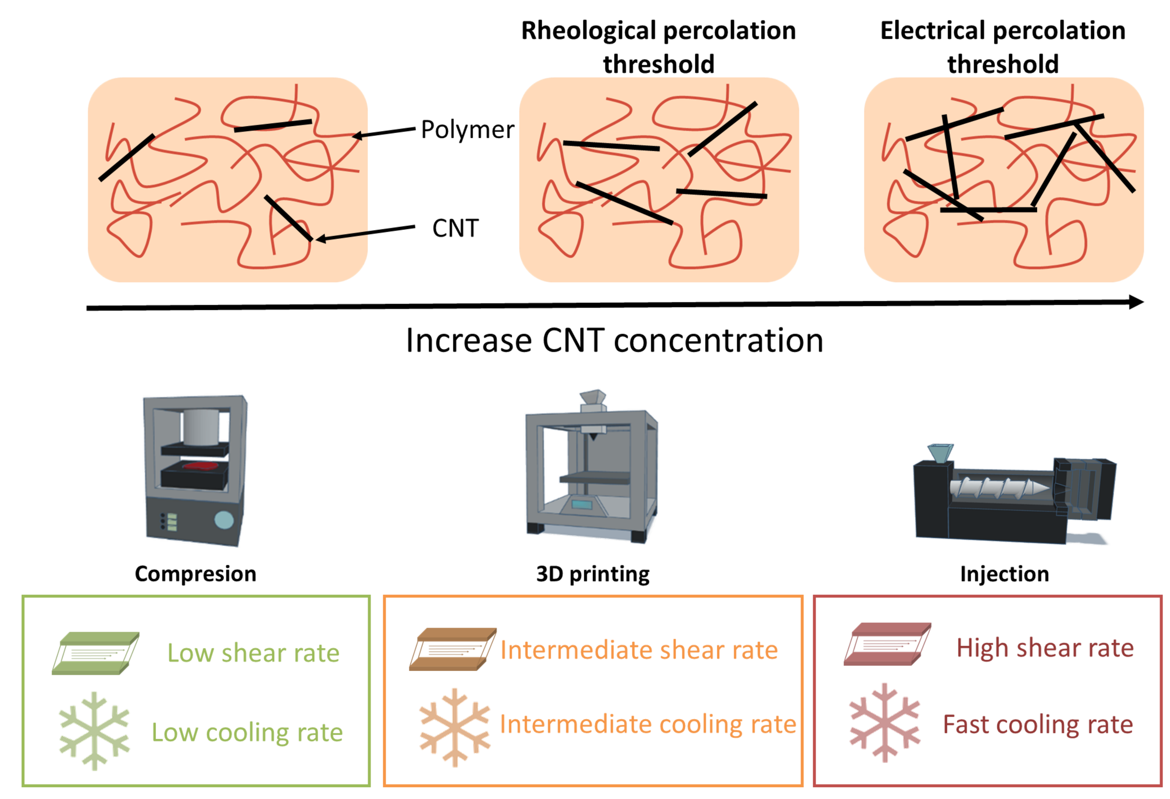
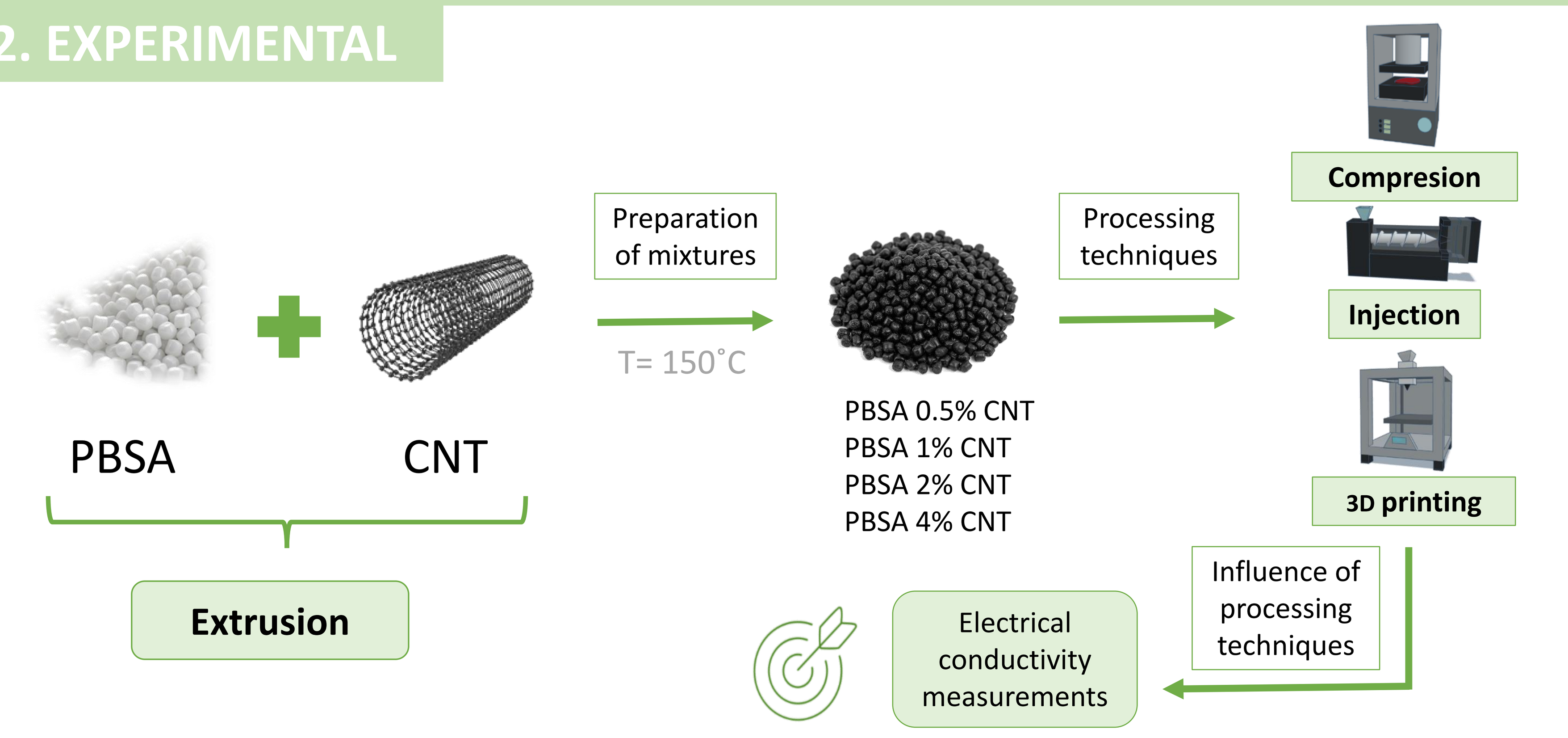
1. INTRODUCTION

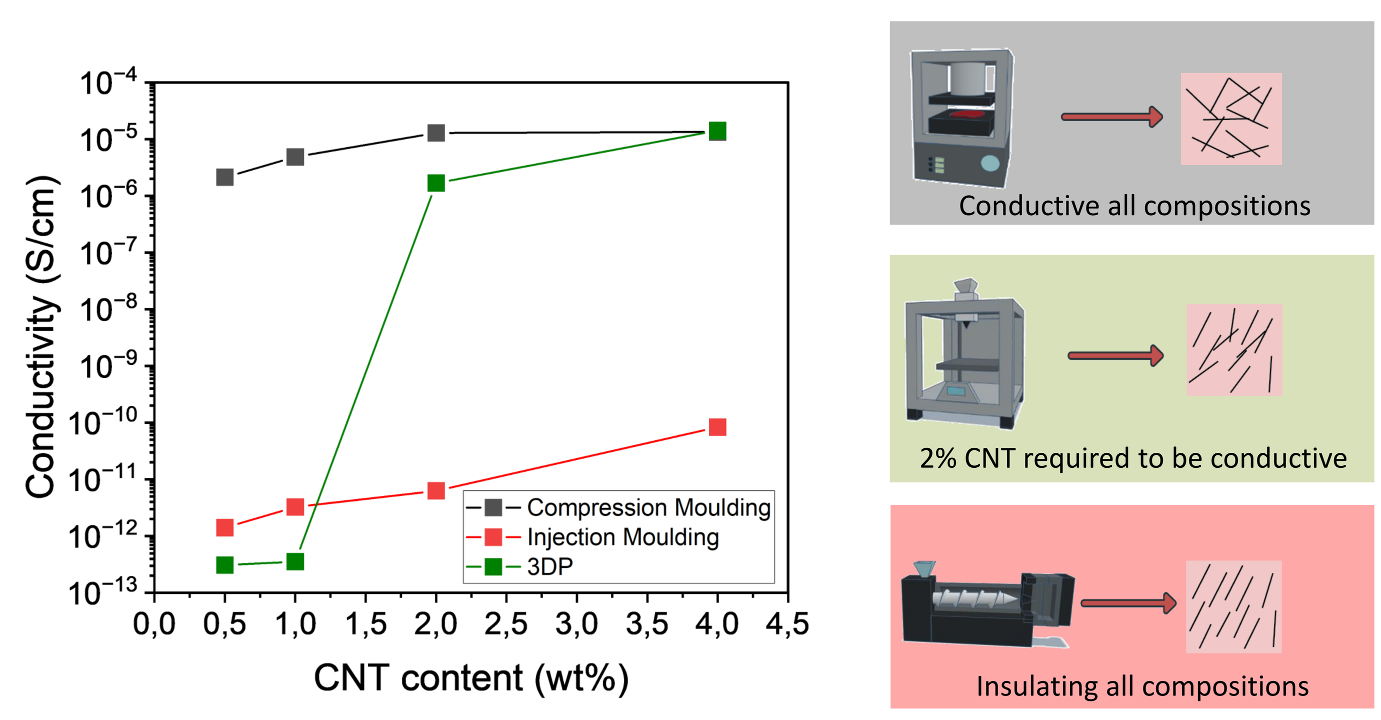
Recent advances in biomedicine and other fields have increased the demand for conductive biopolymers. One of the most effective approaches involves incorporating conductive nanofillers into biopolymers that are processed in the melt state. However, the processing technique greatly impacts both the rheological and electrical percolation thresholds. For example, nanocomposites fabricated via injection moulding or 3D printing experience different shear and cooling conditions, which affect their final electrical performance. Hot pressing, however, applies low shear and slow cooling, reducing the percolation thereshold. This study has developed a methodology based on a combination of rheological and conductivity measurements to determine the processing window in which the material will maintain its conductive properties.

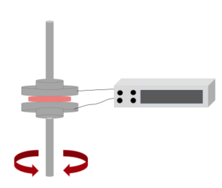


2. EXPERIMENTAL



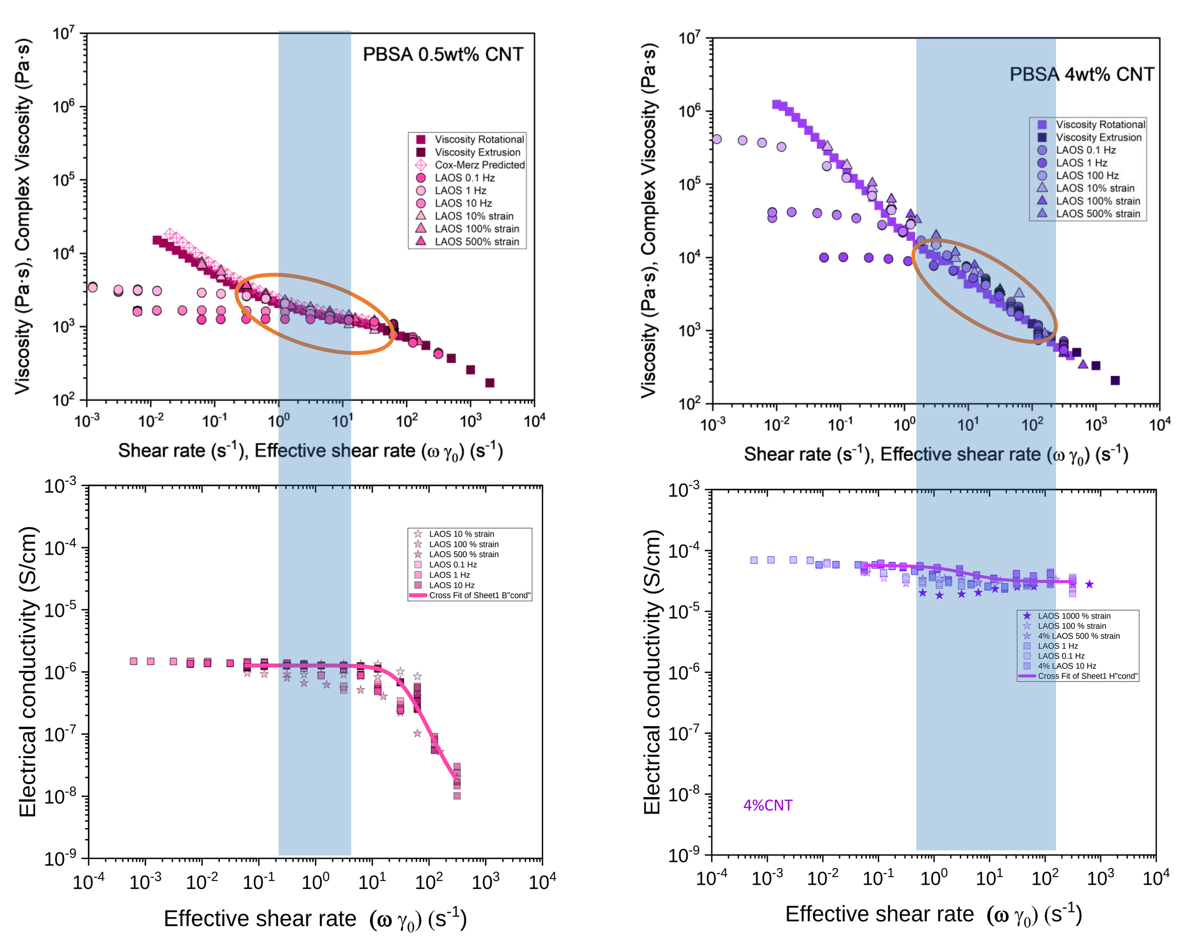
3. RESULTS



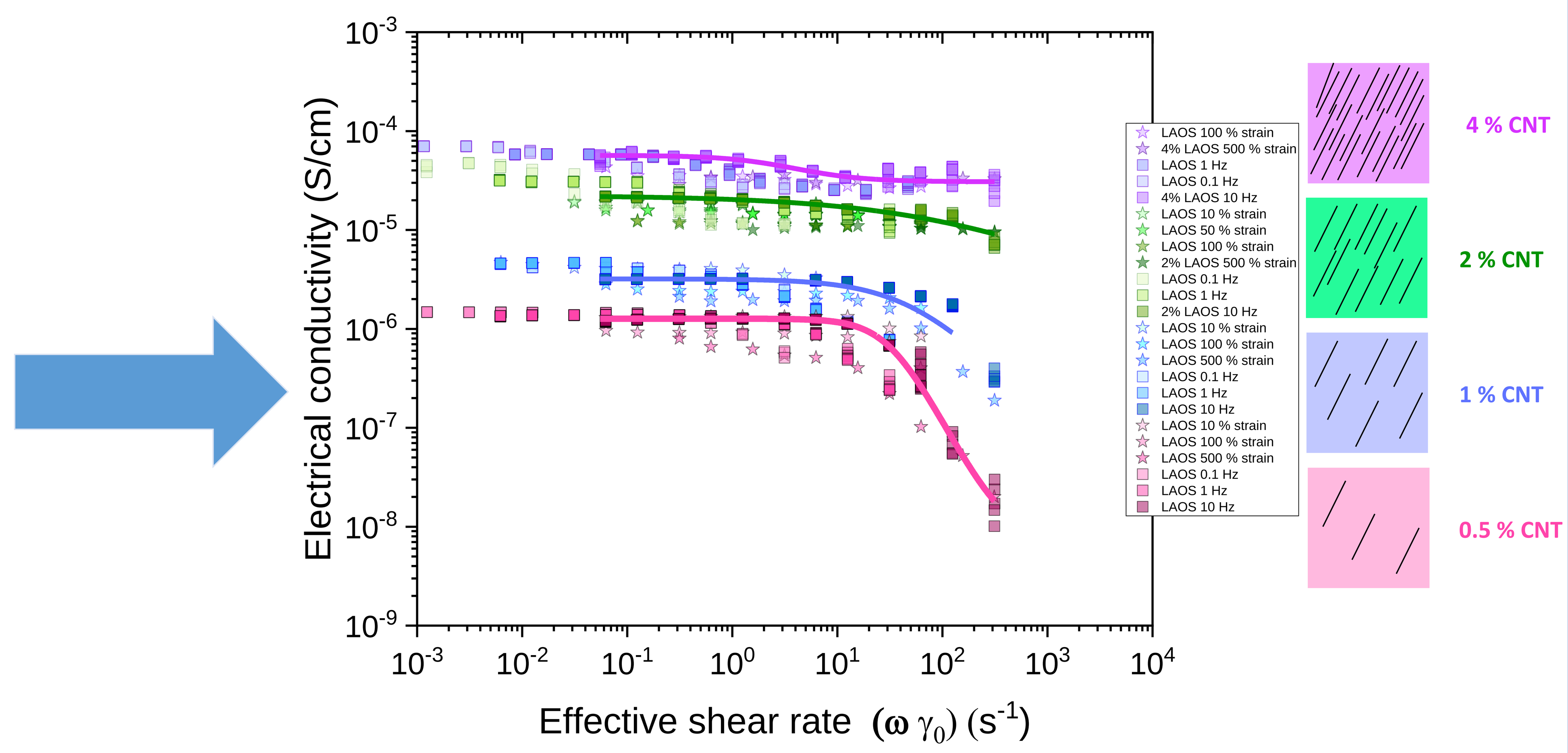


Oscillatory rheology + Conductivity

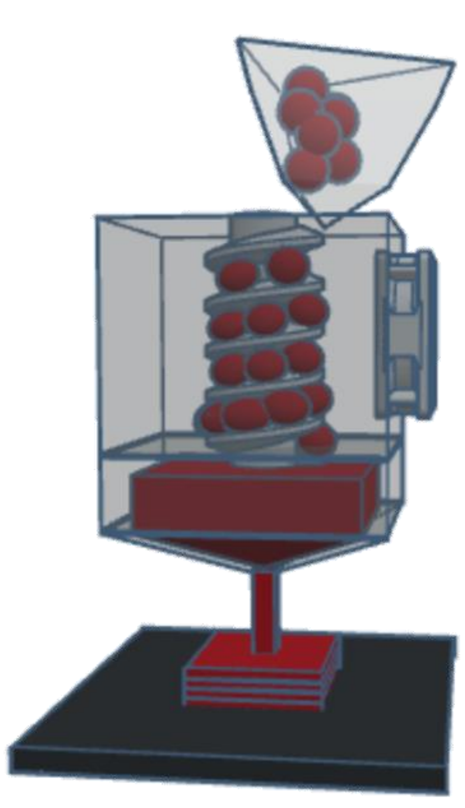
Cox-Merz rule: $\eta(\dot{\gamma}) = |\eta^*(\omega)|_{\dot{\gamma}=\omega}$ → Rutgers-Delaware rule[1]: $\eta(\dot{\gamma}) = |\eta^*(\omega \cdot \gamma_0)|_{\dot{\gamma}=\omega \cdot \gamma_0}$



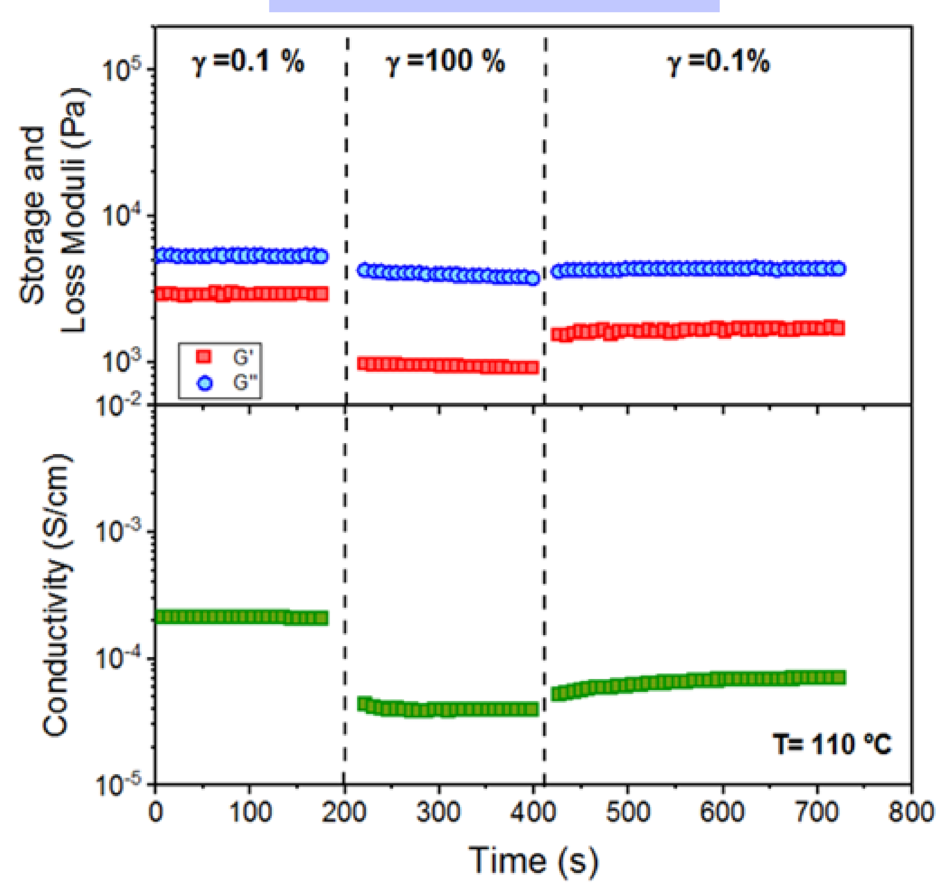
It's possible to stablish the shear rates window (processing conditions) to maintain conductivity.



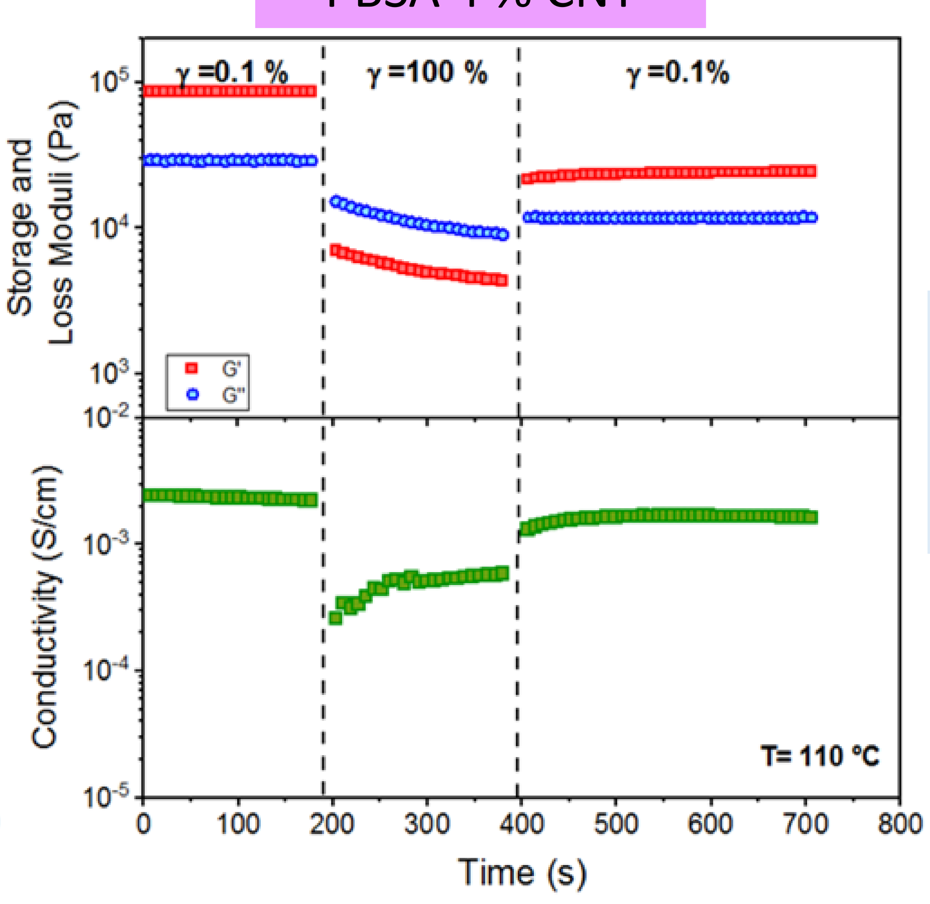
Higher CNT density makes it more difficult to break the conductive network.



PBSA 1 % CNT



PBSA 4 % CNT



- Partial recovery of rheological behavior in both cases.
- Electrical recovery only in the high CNT loading sample

4. CONCLUSIONS

- The shear rates applied during processing have a significant effect on the conductivity of nanocomposites based on biopolymers and conductive nanofillers (CNTs, in this case).
- High shear rates can destroy the connectivity between nanoparticles, reducing or even eliminating this property.
- By combining simultaneous rheological and conductive measurements, it is possible to establish the optimal processing window to maintain the conductive properties of the material.

5. REFERENCES

[1] D. Doraiswamy, A. N. Mujumdar, I. Tsao, A. N. Beris, S. C. Danforth, A. B. Metzner; The Cox–Merz rule extended: A rheological model for concentrated suspensions and other materials with a yield stress. *J. Rheol.* 1 May 1991; 35 (4): 647–685. https://doi.org/10.1122/1.550184

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