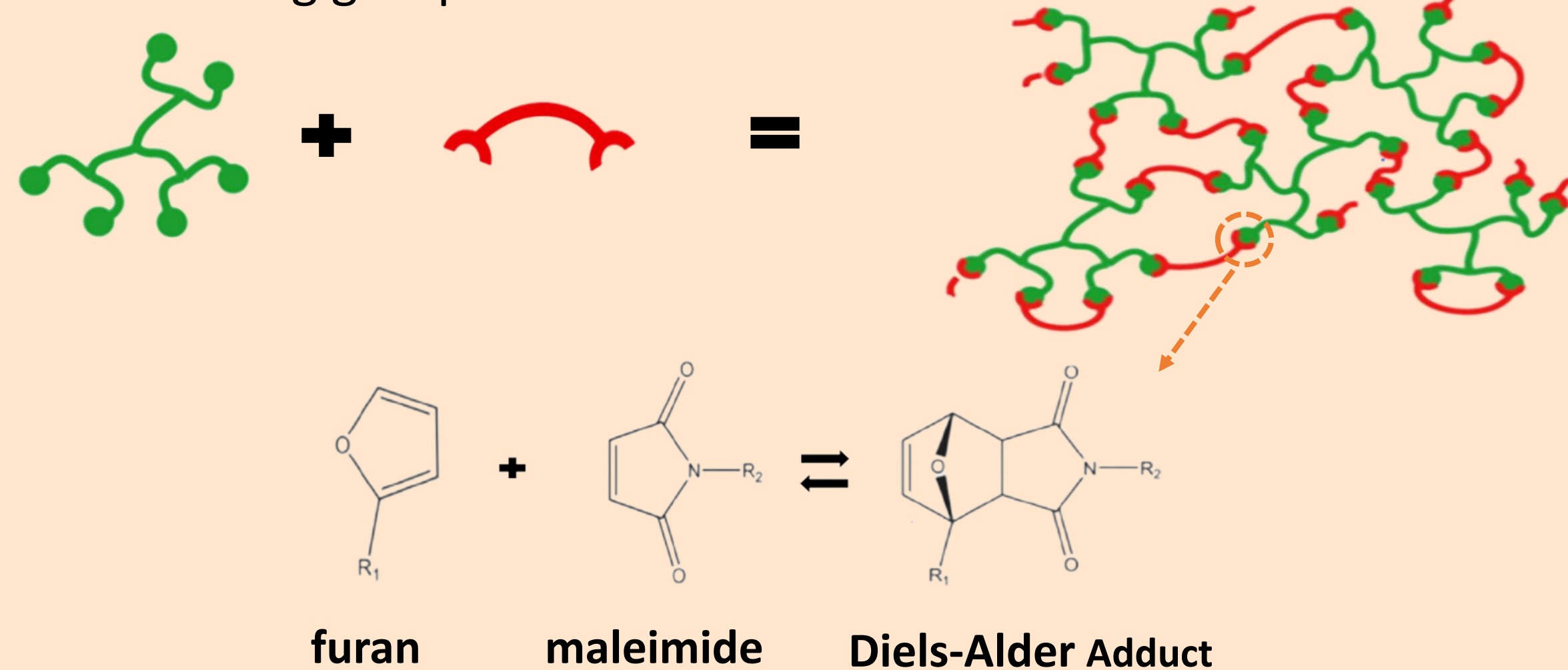


SECONDARY FILLERS IMPROVE THE SELF-HEALING AND ELECTROMECHANICAL PROPERTIES OF DIELS-ALDER-BASED CARBON COMPOSITES

Fatemeh Sahraeeazartamar^{1*}, Zeyu Yang¹, Seppe Terryn², Ellen Roels², Ali Safaei¹, Drazan Jozic³, Bram Vanderborcht², Guy Van Assche¹, Joost Brancart¹

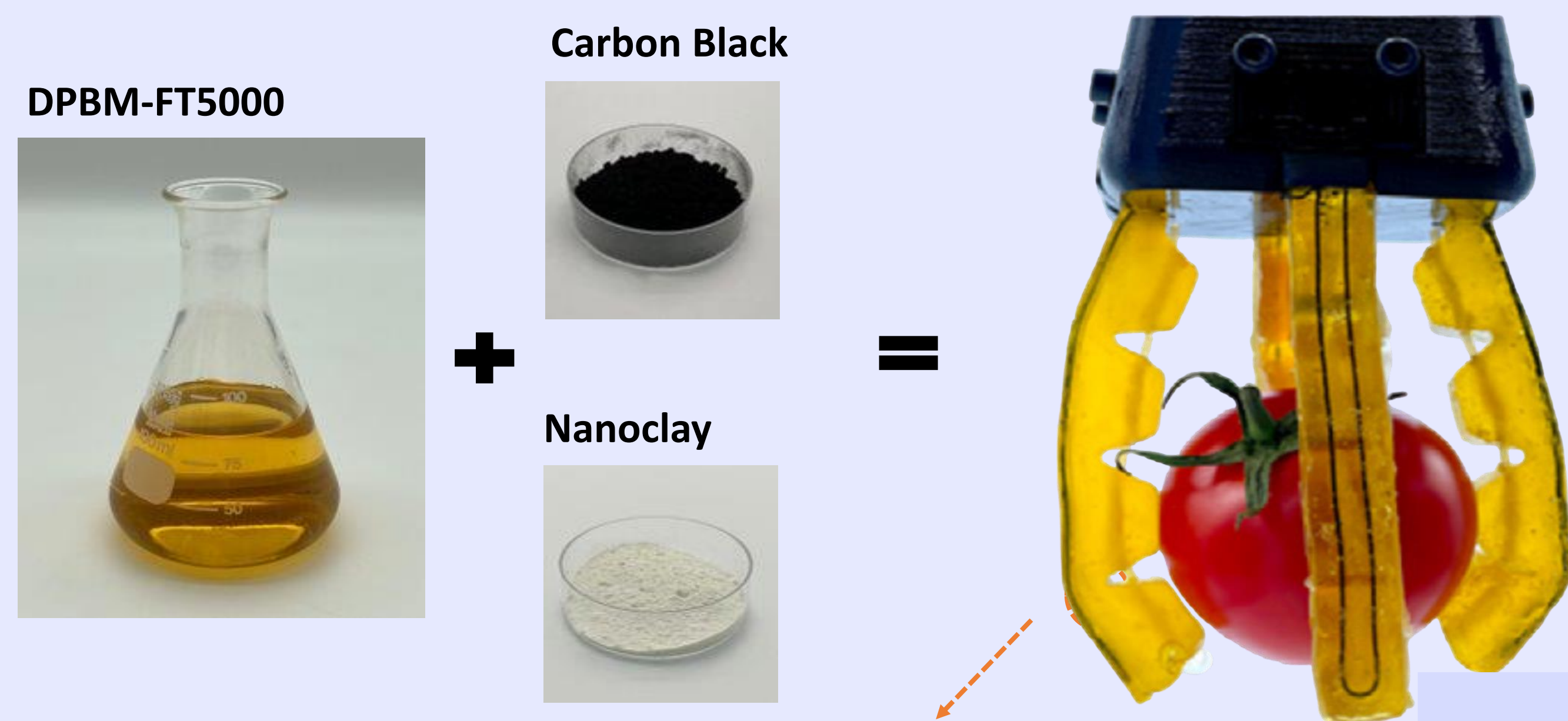
Diels-Alder dynamic covalent bonds

A self-healing Diels-Alder network is formed by reaction between furan and maleimide reacting groups.

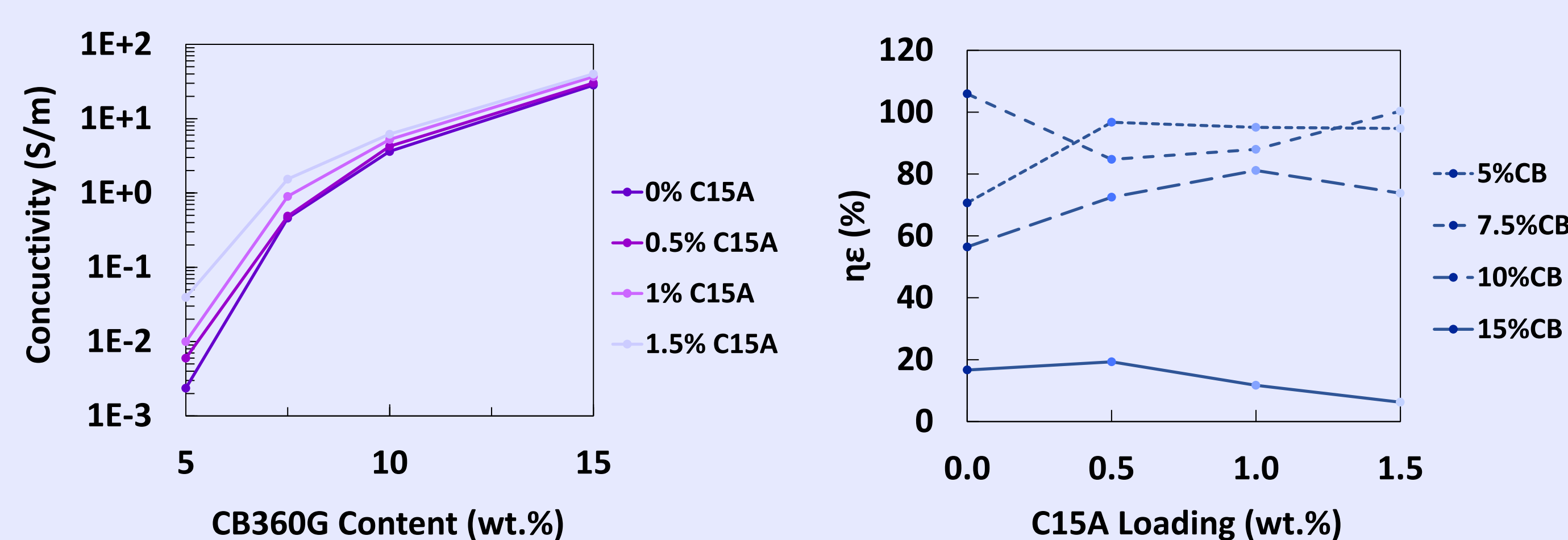
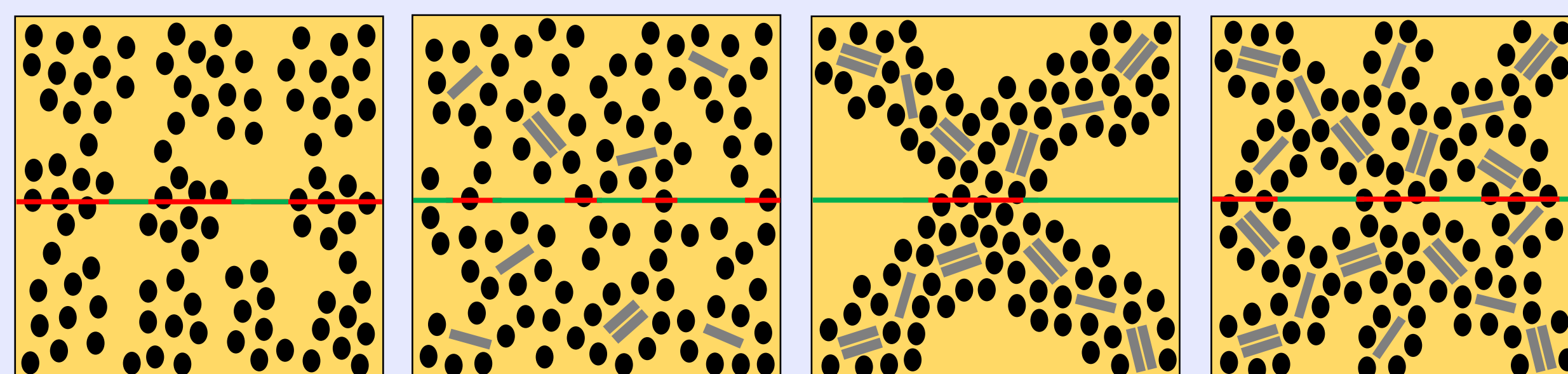


Synergistic effect of carbon black/nanoclay

The introduction of nanoclay synergistically improves both electrical and self-healing properties of CB-filled Diels-Alder networks through changing the morphology of conductive network.

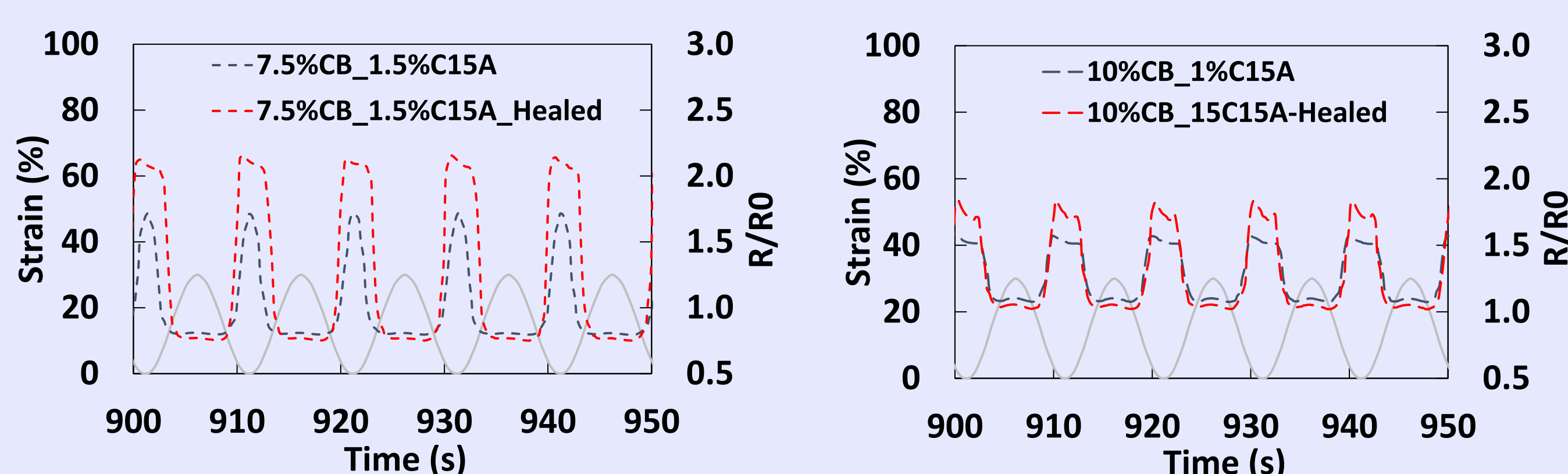


Healing is not possible
Healing is possible



Electromechanical properties of hybrid composite

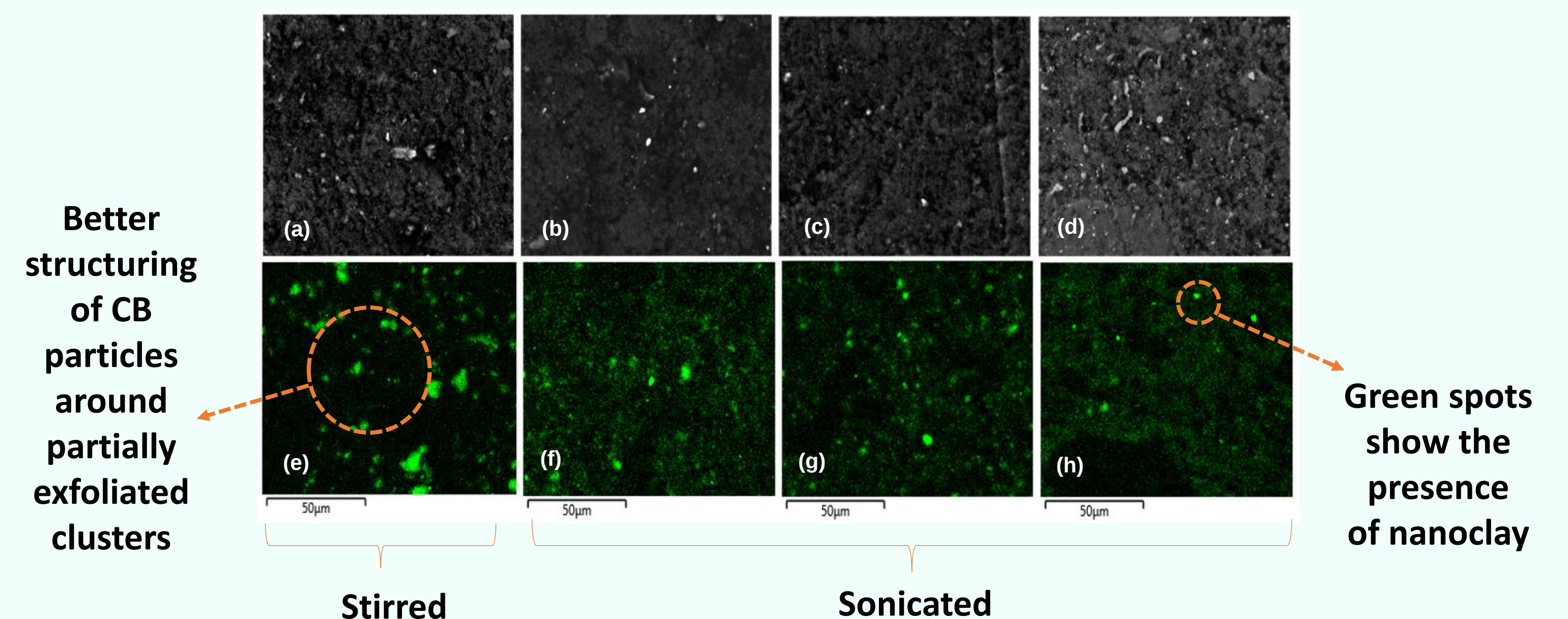
Sensors with different filler compositions show decent sensitivity before and after damage-healing process.



Studying the effect of design parameters:

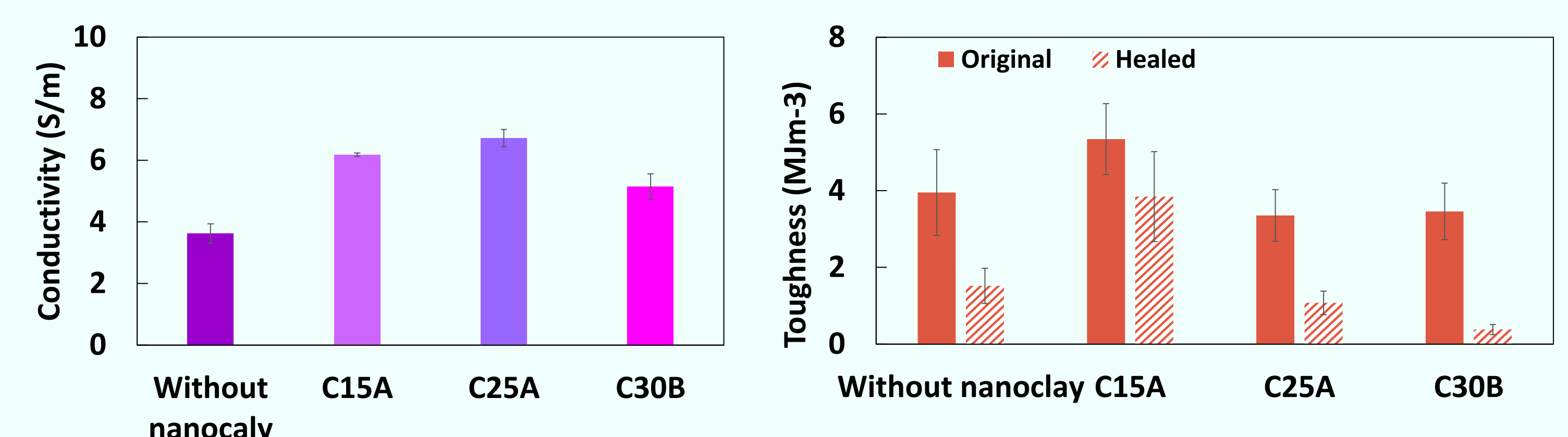
1) Effect of processing conditions (Dispersion of nanoclay)

The sonication process with various times and amplitudes increases the level of exfoliation of nanoclay platelets which does not favor the synergy of combining CB and nanoclay.



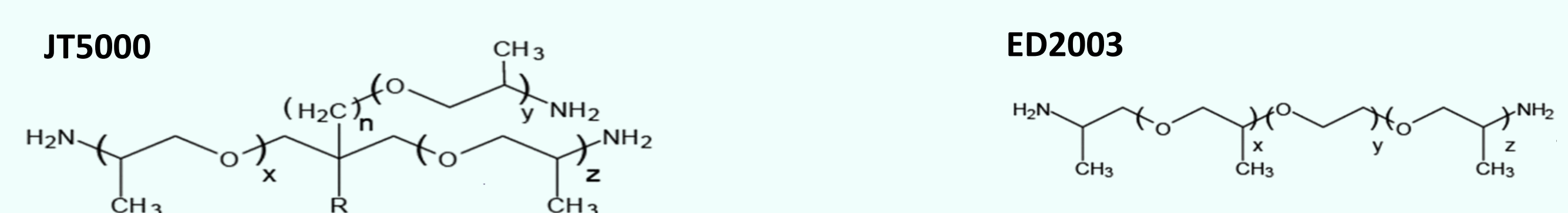
2) Effect of nanoclay type

More hydrophobicity and bigger D-spacing of platelets result in synergistic improvement of electrical and self-healing properties in composites based on DPBM-FT5000_r0.6 matrix.



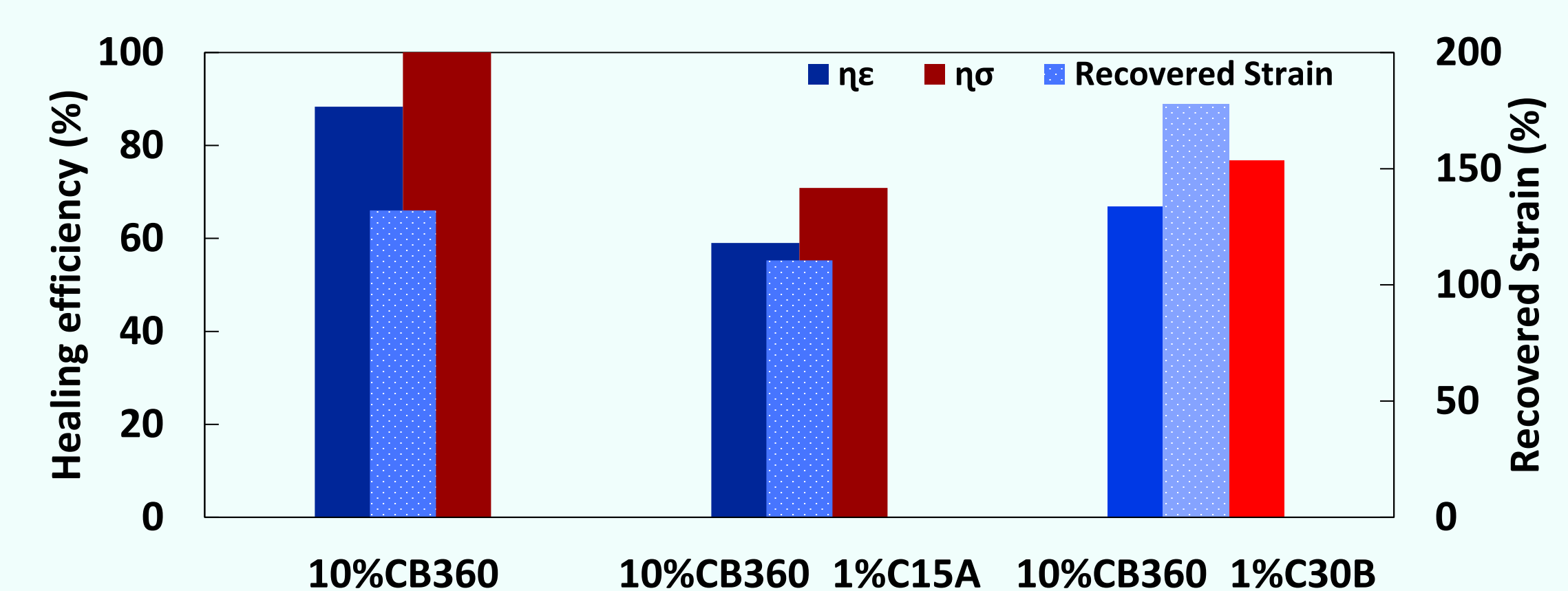
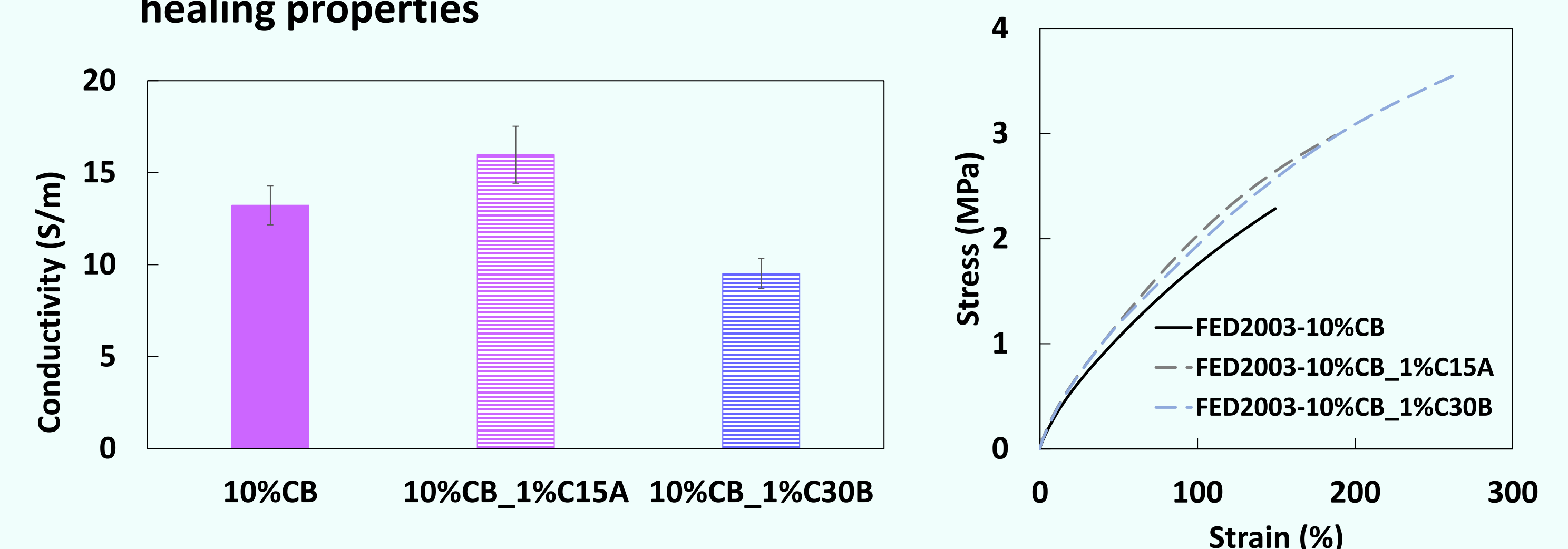
3) Effect of Diels-Alder network

Changing the architecture and chemistry of the network by changing the PPO-based Jeffamine JT5000 to PEO-based ED2003 affects the synergy.



Moreover, in DPBM-FED2003_r0.6 the compatibility between nanoclay with either polymer network or carbon black plays an important role:

- More compatibility with carbon black leads to better electrical properties
- More compatibility with polymer matrix improves mechanical and self-healing properties



References

- [1] S. Terryn, E. Roels, J. Brancart, G. Van Assche, B. Vanderborcht "Self-healing and high interfacial strength in multi-material soft pneumatic robots via reversible Diels-Alder bonds". *Actuators* Vol. 9, pp 1-17, 2020.
- [2] S.K. Tabrizian, F. Sahraeeazartamar, J. Brancart, E. Roels, P. Ferrentino, J. Legrand, G. Van Assche, B. Vanderborcht, S. Terryn "A healable resistive heater as a stimuli-providing system in self-healing soft robots". *IEEE Robot. Autom. Lett.* Vol. 7, pp 4574-4581, 2022.
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