

Phase separation in vitrimeric networks

A. A. Rispo Constantinou^{*1,2}, G. Ianniruberto¹, E. van Ruymbeke², D. J. Read³

¹ Laboratory of Molecular Rheology, Department of Chemical, Materials and Production Engineering,
Università di Napoli Federico II, Piazzale Tecchio 80, 80125 Napoli, Italy

² Bio and Soft Matter, Institute of Condensed Matter and Nanosciences,
Université catholique de Louvain, Place Croix du Sud 1, 1348 Louvain-La-Neuve, Belgium

³ School of Mathematics, University of Leeds, Leeds LS2 9JT, United Kingdom

*alexandrosandreas.constantinou@unina.it

Vitrimeric polymers have recently been proposed as a reprocessable alternative to thermoset plastics [1]. Their potential recyclability stems from the dynamic covalent bonds forming the polymeric network: they are solid-like at low temperatures, but flow when heated. An obstacle to the production of homogeneous vitrimeric plastics is the onset of phase separation during synthesis [2]. Two possible mechanisms exist for the separation into different phases: one is enthalpic, stemming from the interaction between species; the other is entropic, if the network-forming components prefer to form clusters and leave the rest of the sample free to flow.

We propose to investigate this phenomenon using existing theories for associative polymeric networks [3,4] to predict the regimes in which phase separation is favourable, with the goal of providing hints for the experimental design of vitrimeric plastics. Our study focuses on systems with four species: (i) non-reactive homopolymer such as polystyrene, (ii) the same polymer with equally-spaced function sites, binding to either (iii) a difunctional 'cross-linker' moiety or (iv) a monofunctional 'stopper' for the function sites. We aim to identify regimes in which phase separation is stymied, in order to facilitate industrial production.

References:

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