Summer School on Polymeric Networks for Sustainable Development

July 6th – 12th, 2025

Compatibilization of polyolefins for food packaging applications: comparison between Associative CANs and Multiple H-bonding

Francesca Miglioli[1], Silvia D'Auria[1], Enrico Dalcanale[1]
[1] www.dalcanalegroup.unipr.it, *Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Viale delle Scienze 17/A, 43124 Parma, Italy.*
*E-mail: francesca.miglioli1@unipr.it

Recycling food packaging plastics represents a difficult challenge due to the prevalence of multilayer films made of incompatible polymers joined by adhesives[1]. Current recycling procedures for multilayer films are not environmentally sustainable, requiring the use of numerous solvents and producing a large amount of waste[2]. In this work, we aim to obtain a recyclable monolayer film resistant to moisture and oxygen suitable for food packaging applications. The strategy is based on the compatibilization of ethylene vinyl alcohol (EVOH)[3] with polyethylene-co-hydroxyethyl methacrylate (PE-HEMA) via either Associative CANs[4] or Dissociative Polymer Networks based on multiple hydrogen bonding[5]. The first approach exploits the formation of a vinylogous urethane between PE-HEMA and EVOH, functionalized respectively with N[3-(trimethoxysilyl)propyl]ethylenediamine (P3) and tert-butyl acetoacetate (P4). The second approach uses PE-HEMA functionalized with phenyl-urea isocyanate as compatibilizing agent able to form multiple hydrogen bonds. The first case led to a blend (B2) with promising barrier properties, showing an oxygen transmission rate (OTR) of 101 [cc · mm/(m^2 · 24h)]*. The second strategy turned out to be even better, showing an OTR of 36 [cc · mm/(m^2 · 24h)]*, which is less than half that of a pure PE-HEMA. Furthermore, the processability of both materials is possible thanks to the dynamic and thermoreversible nature of their cross-links.

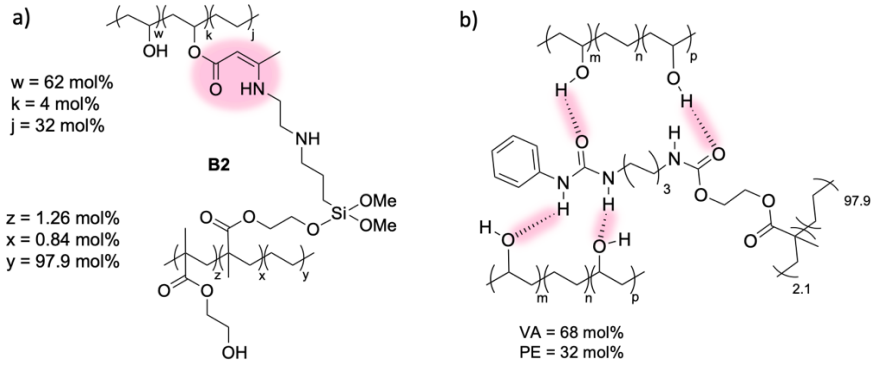

Figure: a) Vinylogous urethane blend synthesis. b) Phenyl-urea isocyanate as cross-linking agent.

**at 23°C and 50%RH (ASTM F1307).*

References:

[1] Sanchez-Rivera, K. L.; Zhou, P.; Kim M. S.; Gonzalez Chavez, L. D.; Grey, S.; Nelson, K.; Wang, S.; Hermans, I.; Zavala, V. M.; Van Lehn, R. C.; Huber, G. W.; ChemSusChem ***2021****, 14, (4317).*
[2] Tajeddin, B.; Arabkhedri, M.; Polym. Sci. Innov. Appl., Elsevier, ***2020****, (525).*
[3] Robertson, P. L.; Verona, G., Aust. Econ. Hist. Rev. ***2006****, 46, (70).*
[4] Scheutz, G. M.; Lessard, J. J.; Sims, M. B.; Sumerlin, B. S.; J. Am. Chem. Soc. ***2019****, 141, (16181).*
[5] For a previous work using dissociative bonds see: D'Auria, S.; Pedrini, A.; Ferraboschi, I.; Vachon, J.; Sissa, C; Pinalli, R.; Dalcanale, E.; Soft Matter, ***2023****, 19, (1900).*