Biodegradable Polymers from Renewable Resource Materials

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In recent decades, significant research has focused on reducing fossil-fuel dependence and building a more sustainable future, specifically through the use of polymers from renewable resources. One approach toward sustainability has been to investigate feedstock's that have short carbon cycles, such as plants, as alternatives to petroleum-based feedstock. A more elegant solution is to develop materials that both come from renewable resources and can be easily recycled into their feedstock, thus creating a cradle-to-cradle life cycle. However, the challenge is to develop biodegradable materials that can compete with conventional polymers in terms of processability, mechanical and thermal properties, durability and cost.

The environmental concerns have led to the development of biorenewable polymers with the ambition to utilize them at an industrial scale. Poly(lactic acid) and poly(hydroxyalkanoates) are semi-crystalline, biorenewable polymers that have been identified as the most promising alternatives to conventional plastics. However, both are inherently susceptible to brittleness and degradation during thermal processing. In the present work, we discuss several approaches to overcome these problems to create a balance between durability and biodegradability. For example, the preparation of copolymers and blends can increase ductility and the thermal-processing window. Furthermore, chain modifications such as branching or crosslinking, the processing techniques such as fiber drawing or annealing, or additives such as plasticizers or nucleating agents can improve the mechanical properties and prevent the thermal degradation during processing.

References:

[1] Tsui A.; Wright Z.C.; Frank C.W. Annu. Rev. Chem. Biomol. Engg. **2013**, 4, 143-170.

[2] Tschan M.J.L.; Brule M.; Haquette P.; Thomas C.M. Polym. Chem. **2012**, 3, 836-851.

[3] Auras R.A.; Lim L.T.; Selke S.E.M.; Tsuji H.; Poly(lactic acid) : Synthesis, Structures, Properties, Processing and Applications, **2010**, John Wiley and Sons, USA.