Title:

The role of cross fractionation chromatography in the context of the development of mechanochemical polymer recycling

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Reference 1: I. Vollmer, M. J. Jenks, M. C. Roelands, R. J. White, T. van Harmelen, P. de Wild, G. P. van der Laan, F. Meirer, J. T. Keurentjes, B. M. Weckhuysen, Angew. Chem. 2020, 132 (36), 15524-15548.
Reference 2: M. Fischlschweiger, Chem. Ing. Tech. 2022, 94, 1290-1291.
Reference 3: Z. Fan, L. Steuernagel, M. Fischlschweiger, Macromol. Chem. Phys. 2022, 223, 2200206.
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Images:

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Abstract:

The use of plastics has increased enormously in recent decades and has contributed significantly to economic growth [1]. A wide variety of properties and tailorable characteristics of polymers are the basis for a wide range of applications of polymeric products. On the other hand, due to their high durability, most polymers are not easily degraded by microorganisms when they enter the environment [1,2]. This has a significant impact on ecosystems and human health [1,2]. In the context of sustainability, energy-efficient recycling technologies for polymers are of great importance. Today, there are four main recycling strategies: mechanical and mechanochemical recycling, chemical recycling, dissolution/precipitation-based recycling and incineration with energy recovery combined with carbon capture and storage [1,2]. For mechanical recycling, polymer blends produced from plastic waste by extrusion melt blending are particularly important in the context of tailoring material properties for value-added applications [3]. For property tailoring and downcycling suppression, it is essential to understand the thermomechanical degradation behaviour of the blends induced by melt blending. In this work, we demonstrate how cross-fractionation chromatography can help to further understand the thermomechanical degradation behaviour induced by melt-blending and how the induced changes in molecular architecture are related to process parameters and mechanical properties, such that mechanochemical recycling can be used to enhance properties. PP/PS blends are applied as demonstration examples.