

## Microstructural Defects Increase the Fracture Energy of Semicrystalline Semiaromatic Copolyamides

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The extraordinary property profiles of many biological materials derive from their hierarchical structure as well as from the control of order and disorder at different length scales. Application of these concepts to the design of synthetic polymers may open up new routes to lightweight materials that combine high stiffness, strength, and toughness. Here, we use high-temperature melt compounding to introduce aliphatic substitutional defects into the crystalline phase of a high performance semiaromatic copolyamide [1]. This strategy allows us to generate disorder in the crystalline phase and compositional gradients at the amorphous-crystalline interfaces while maintaining, or even increasing the macroscopic degree of crystallinity. This leads to copolyamides whose room temperature yield stress and stiffness rival those of the base semiaromatic polyamide, while at the same time showing a more than five-fold increase in strain to fail and nominal tensile toughness. Tailoring the concentration of molecular scale defects is hence a straightforward and powerful means of optimizing performance in semicrystalline polyamides.

[1] J. Cretenoud, S. Galland, C. J. G. Plummer, V. Michaud, A. Bayer, N. Lamberts, B. Hoffmann, H. Frauenrath, *J. Appl. Polym. Sci.*, **2017**, *134*, 44349.