

# **Thermodynamics of Polymer Blends**

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During a long period of when polymers were becoming the materials of choice for many commercial products, the standard approach for addressing the evolution of performance needs in the market place was to synthesize new polymers or copolymers from the existing array of monomers and to develop viable processes for making them. In metal technology a different strategy involving blending or alloying existing metals quickly emerged. Eventually the field of polymer technology adopted a similar strategy of blending existing polymers. It was quickly learned that, as with metals, the phase structure of the blend was a key element in material performance. At one extreme the blend could be homogeneous if the polymers were miscible or they could (and usually did) form separate phases. This is a question of mixing thermodynamics; the free energy of mixing must be negative for miscibility. With the evolution of polymer science theory it was soon recognized that the entropy of mixing high molecular weight molecules was very small and unfavorable for mixing; this shifts the need for an exothermic heat of mixing to have miscibility. Because of the high viscosity of molten polymers, measuring the heat of mixing directly was out of the question. Some years ago our group decided that measuring the heat of mixing of low molecular weight liquids whose molecular structures were similar to the polymer repeat units, i.e. polymer analogues, might be a useful alternative to such information. This talk will summarize some of the utility of this approach for quantifying the thermodynamics of polymer blending.