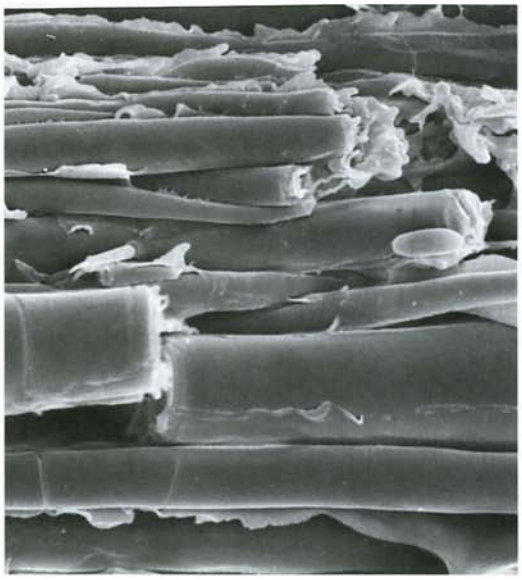

Solidification of Structured Melts, D. A. Zumbrunnen and Y. H. Liu, Laboratory for Materials Processing and Industrial Mixing, Department of Mechanical Engineering, Clemson University.

When melts are composed of immiscible substances, unique opportunities exist whereby extended fine-scale structures can be formed directly in the melt and subsequently captured by solidification. Such structures can have improved properties in comparison to unstructured materials of similar composition. In the upper photograph, recursive stretching and folding events of chaos were instilled within a mixing cavity to yield very rapid reductions in the sizes of melted thermoplastic minor phase bodies (Zumbrunnen et al., 1996). Lamellae of about 1 μm thickness appear in cross section as dark bands. Such structures can be especially effective as permeability barriers, for example. When interfacial tension is sufficient as in the scanning electron micrograph on the lower left, molten lamellae or thicker sheets eventually subdivide due to interfacial instabilities. The instabilities lead to the formation of interconnected fiber shafts of less than 10 μm diameter, as shown on the lower right, that may improve strength and toughness (Liu and Zumbrunnen, 1996). Since the microstructures are formed in the molten state and must be captured by solidification, heat transfer plays an important role in the formation of these novel materials. Both desirable and undesirable microstructural changes can occur upon application of temperature gradients. These effects must be understood so that effective manufacturing processes can be developed.