doi:10.1351/goldbook.MT07230

miscibility

Capability of a mixture to form a single phase over certain ranges of temperature, pressure, and composition.

Notes:

1. Whether or not a single phase exists depends on the chemical structure, molar-mass distribution, and molecular architecture of the components present.
2. The single phase in a mixture may be confirmed by light scattering, X-ray scattering, and neutron scattering.
3. For a two-component mixture, a necessary and sufficient condition for stable or metastable equilibrium of a homogeneous single phase is

   $$\left(\frac{\partial^2 \Delta_{\mathrm{mix}} G}{\partial \phi^2}\right)_{T,p} > 0,$$

   where $\Delta_{\mathrm{mix}}G$ is the Gibbs energy of mixing and ϕ the composition, where ϕ is usually taken as the volume fraction of one of the components. The system is unstable if the above second derivative is negative. The borderline (spinodal) between metastable and unstable states is defined by the above second derivative equalling zero. If the compositions of two conjugate (coexisting) phases become identical upon a change of temperature or pressure, the third derivative also equals zero (defining a critical state).
4. If a mixture is thermodynamically metastable, it will demix if suitably nucleated. If a mixture is thermodynamically unstable, it will demix by spinodal decomposition or by nucleation and growth if suitably nucleated, provided there is minimal kinetic hindrance.

Source:

PAC, 2004, *76*, 1985 *(Definition of terms related to polymer blends, composites, and multiphase polymeric materials (IUPAC Recommendations 2004))* on page 1987