ability in maintaining drug supersaturation. Such a supersaturation can result in enhanced absorption of drugs that exhibit solubility-limited absorption (Shanker 2005).

CHARACTERIZATION OF SOLID DISPERSION

Various techniques available for characterization of solid-state properties of raw materials and finished solid dispersions are presented in this section. In most cases, solid dispersions are processed into finished dosage forms using conventional approaches such as tabletting, encapsulation, and so forth, and the characterization of such finished dosage formulations are not presented here.

Modulated Differential Scanning Calorimetry

The differential scanning calorimetry (DSC) works on a technique that detects physicochemical transition in a system by measuring the amount of heat absorbed or released as the sample is heated across its suspected transition range. The heat absorbed or released from a sample of known mass is compared with that of an empty reference pan. Modulated differential scanning calorimetry (mDSC) works on an advanced technology version of DSC, where the signal quality has been improved using a mathematical function built in the software. Calorimetric approach provides valuable information to evaluate the structure of the dispersion using sample size as low as 10–20 mg. However, one disadvantage of DSC is that the method is destructive in nature, and may possess certain artifacts. For instance, when DSC was used to characterize the structure of oxidipine and griseofulvin solid dispersion in PEG 6000, it was observed that the endotherm attributed to melting of drug was undermined because the drug was dissolving in the molten carrier when the sample was heated in DSC (Veiga et al. 1993a).

Powder X-ray Diffraction

Powder X-ray diffraction (PXRD) is a noninvasive technique that measures the diffraction pattern of drug and/or polymer with sample size as low as 200 mg. A detectable diffraction phenomenon occurs when a crystalline material, owing to its structural periodicity, scatters X-ray. Each crystalline ingredient possesses an X-ray pattern, which is specific to the manner in which the packing occurs. An X-ray pattern of solid dispersions typically reveals loss in crystalline structure and changes in crystal packing (i.e., polymorphism or formation of crystalline solid solution). A major disadvantage of X-ray is its inability to differentiate between amorphous components, as amorphous materials generate a characteristic halo. Several advanced versions of X-ray diffraction are now available such as wide-angle X-ray scattering, X-ray equipped with relative-humidity control, high-temperature X-ray, and so forth, which have rendered solid-state characterization easier.

Hot-Stage Microscopy

Hot-stage microscopy (HSM) is a valuable technique that often complements DSC measurements by providing a visual assessment of solid dispersion structure. It is more suited to crystalline solid dispersions than to amorphous ones, as the latter lacks the birefringence needed for its visual detection. While thermal analysis could undermine the physical structure of drug in a solid dispersion by dissolving it in the molten polymer, HSM can determine physical structure of drug by characterizing as low as ~2% w/w of crystalline drug in a polymer with low melting point. In one study, HSM was successfully applied to detect crystalline felodipine and hesperetin in PEG matrix, which could not be detected using DSC (Bikiaris et al. 2005). The disadvantage of thermal analysis in characterizing the drug dispersed in polymer with low melting point can alternatively be overcome by using microthermal analysis (μTA). μTA technique combines microscopy and thermal analysis, and can locally heat the mixture to melt only the drug without melting the lower melting point excipient (Galop 2005).