

properties, such as heat capacity, mechanical modulus, sample mass, and dimensional changes in temperature ranges between -150°C and 1600°C . Thermal analysis utilizes DSC, TGA, TMA, and dynamic mechanical analysis instrumentation supplemented by software products, accessories, consumables, and documentation. Applications are frequently found in research and quality control environments. They cover the characterization of materials, process development, and evaluation, as well as safety investigations. All METTLER TOLEDO thermal analysis products belong to the latest-generation STARe family. The associated METTLER TOLEDO FP900 series includes instruments for the rapid determination of physical properties, such as melting, boiling, dropping, and softening points.

Microthermal analysis is a recently introduced thermoanalytical technique that combines the principles of scanning probe microscopy with thermal analysis via replacement of the probe tip with a thermistor. This allows samples to be spatially scanned in terms of both topography and thermal conductivity, whereby placing the probe on a specific region of a sample and heating, it is possible to perform localized thermal analysis experiments on those regions.

3.5.4 Molecular Spectroscopy

The foundations for fluorescence correlation spectroscopy (FCS) were already laid in the early 1970s, but this technique did not become widely used until single-molecule detection was established almost 20 years later with the use of diffraction-limited confocal volume element. The analysis of molecular noise from the GHz to the Hz region facilitates measurements over a large dynamic range covering photophysics, conformational transitions, and interactions, as well as transport properties of fluorescent biomolecules. From the Poissonian nature of the noise spectrum, the absolute number of molecules is obtainable. Originally used for the analysis of molecular interactions in solutions, the strength of FCS lies also in its applicability to molecular processes at either the surface or interior of single cells. Examples of the analysis of surface kinetics, including on and off rates of ligand–receptor interactions, will be given. The possibility of obtaining this type of information by FCS will be of particular interest for cell-based drug screening.

Recrystallization, grinding, compaction, and freeze-drying are used frequently in the pharmaceutical industry to obtain a desirable crystalline form of bulk powder and excipients. These processes affect not only the surface area but also the crystalline disorder of the powder materials. Because both these parameters may affect the bioavailability of a drug through the rate of dissolution, it is necessary to control the conditions under which the pharmaceutical drug powders are produced. The extent of disorder in a crystalline solid may induce the hygroscopicity of the drug, in addition to the flow, mechanical properties, and chemical stability. Because the qualities of a pharmaceutical preparation depend on the characteristics of the bulk powders and excipients, controlling the production process is important. An amorphous solid-state powder may determine the bioavailability of a slightly water-soluble drug, because the property affects solubility and, hence, absorption of the drug in the gastrointestinal tract. However, the amorphous form has problems regarding stability and hygroscopicity, resulting in transformation to a more stable crystalline form during preservation.

Therefore, in order to control the quality of pharmaceutical solid dosage products, techniques for the evaluation of crystallinity of the bulk powders and/or excipients