The major advantage of FTIR is that it can be used in analysis of solid dosage forms. Examples of use of FTIR to investigate storage conditions and formulation variables of mAbs include studies on an anti-IgE mAb after freeze drying (Andya, Hsu, & Shire, 2003) and spray drying (Costantino, Andya, Shire, & Hsu, 1997).

Additional biophysical methods

Mass spectrometry

In early development of a formulation of proteins and mAbs various high-throughput assays such as chromatographic-based assays are evaluated over time of storage at different formulation conditions at different temperatures. Although changes in the assay are easily determined, the use of mass spectrometry coupled with peptide mapping has enabled identification of the actual sites and chemical route of degradation. There are some excellent reviews and discussions on mass spectrometry, which essentially can determine with high precision the mass of peptides altered in the protein structure due to chemical degradation (Biemann, 1995; Bourell, Clauser, Kelley, Carter, & Stults, 1994; Lanucara, Holman, Gray, & Eyers, 2014; Papac & Shahrokh, 2001).

Surface plasmon resonance

Surface plasmon resonance (SPR) technology has been used to obtain kinetics and equilibrium data without the requirement of having to label any of the interacting molecules (Hodgson, 1994), and has been extremely useful in obtaining binding data with high affinity (Day, Capili, Borysenko, Zafari, & Whitty, 2013). The basic principle is the behavior of light at boundaries with different refractive indices. At the interface of a higher refractive index surface (the sensor) and a lower refractive index solution, light internally reflects beyond a critical angle. The internal reflection creates an electromagnetic field, the evanescent wave, that tranverses from the interface into the solution. The angle at which this wave is greatly enhanced is the resonance angle and is extremely sensitive to the refractive index changes at the sensor surface. These changes are related to the mass of binding molecules to the target molecule that is captured on a dextran-coated gold surface of the sensor. Since one of the binding molecules must be immobilized onto the sensor surface a caveat of this technology is the dependence of the determined binding affinity constants on the orientation, method of binding, and which of the binding molecules are immobilized on the surface (O'Shannessy, 1994; Trilling, Harmsen, Ruigrok, Zuilhof, & Beekwilder, 2013).

Analytical ultracentrifugation

Analytical ultracentrifugation (AUC) is probably one of the best methods for quantitative studies of protein interactions (Schachman, 1989). There are many reviews and books that discuss this biophysical method (Harding, Rowe, & Horton, 1992; Schachman, 1959; Schuster & Laue, 1994; Teller, 1973).

Protein solutions are analyzed while centrifuging in a well-defined centrifugal field. Current commercially available analytical centrifuges consist of a centrifuge