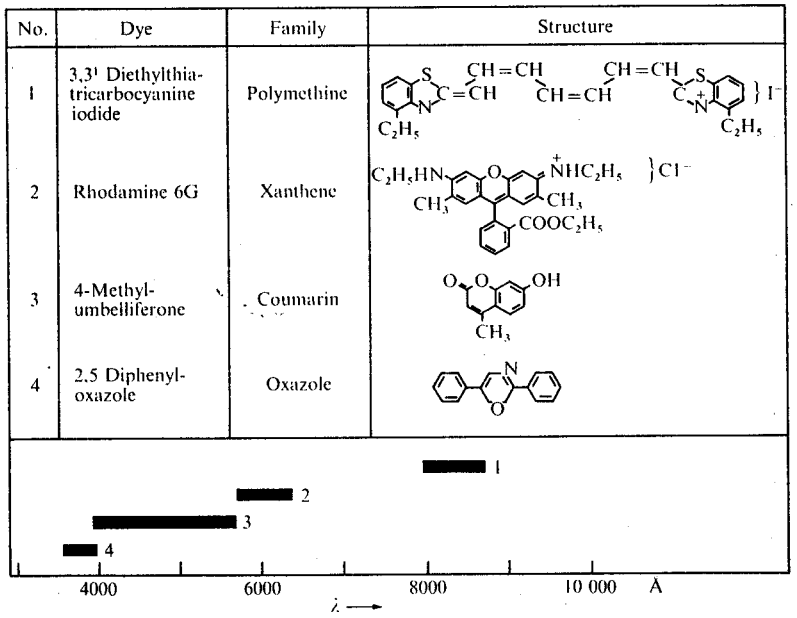

Fig.14.3. Examples of laser dyes, their structure and respective tuning ranges. (After Hänsch (1973).)

range of the spectrum from the near ultraviolet to the yellow, 390-544 nm, using 4-methyl-umbelliferone and its excited acidic complex. Mixtures of different dyes in the same solution have also been used to extend the tuning range or to transfer energy to a dye whose absorption bands did not match the emission of the pump source. However, for use in high-resolution spectroscopy wide tuning range in a single dye is of less importance than high fluorescence efficiency. Happily new dyes which have been especially synthesized for high efficiency over particular spectral regions are becoming increasingly available. The fluorescence efficiency, the triplet losses, and the absorption spectrum of the dye all impose stringent requirements on the properties of the dye laser pump source and we now turn to a consideration of the main types of sources used at present.

14.2.2. Flashlamp - pumped dye lasers. Many laser dyes with emission bands ranging from the near ultraviolet to the infrared have been successfully pumped using flashlamps. These lamps consist of quartz tubes filled with xenon or some other gas at a relatively high pressure and they are excited by a pulsed high-current discharge from a storage capacitor. Flashlamps with short risetimes, of the order of 100 ns or less, are the most suitable for use with dye lasers. The flashlamp and dye cell may be coaxial or alternatively the lamp and cell may be held at the foci of an elliptical cylindrical reflector as indicated schematically in Fig.14.4. Difficulties are encountered in these lasers

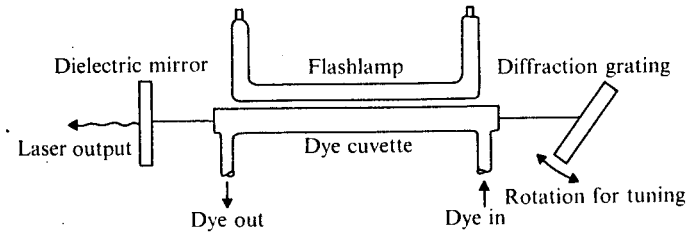

Fig.14.4. Schematic diagram of flashlamp-pumped dye laser. (After Hänsch (1973).)

because of the large amount of thermal energy transferred to the dye solution. This causes refractive index variations throughout the dye cell and leads to very large diffraction losses in the optical cavity. In order to overcome these thermal schlieren effects, the solution is usually circulated rapidly through the dye cuvette by means of a small pump.

In order to achieve a narrow bandwidth tunable output one mirror of the normal laser cavity is usually replaced by a diffraction grating as shown in Fig.14.4. The grating normal makes an angle θ with the axis of the cavity and in this Littrow arrangement the condition

$$2\,d\sin\theta = m\lambda \qquad m = 1, 2, \ldots\ldots \qquad (14.1)$$