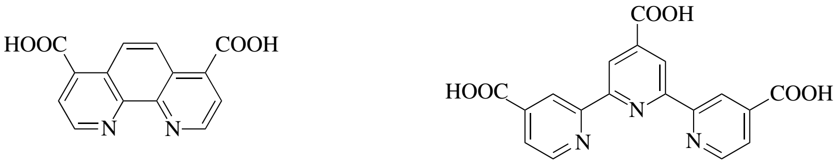
4, 4'-Dicarboxy-2, 2'-bipyridine [6, 103]

5, 5'-Dicarboxy-2, 2'-bipyridine [102]

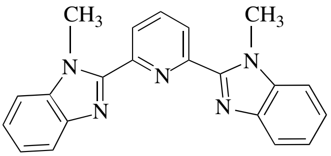


4, 7-Dicarboxy-1, 10-phenanthroline [111, 115, 117]

4, 4', 4''-Tricarboxy-2, 2':6', 2''-terpyridine [7, 8, 122]

4, 4'-Dicarboxy-2, 2'-biquinoline [103, 114]

4-Carboxy-2-(2'-pyridyl)quinoline [121]



2, 6-Bis(1-methylbenzimidazol-2-yl) pyridine [103]

Figure 15.11 Molecular structures of ligands for Ru complex photosensitizers

performances as photosensitizers in the DSSC have been reported by many researchers [101–122]. Several ligands for Ru complex photosensitizers are shown in Figure 15.11 and the structures of new metal complex photosensitizers and their absorption properties are shown in Figure 15.12. The y-axis is represented by molar absorption coefficient, ε (i.e. absorption coefficient per M, unit M^{-1} cm^{-1}).

For example, a Ru phenanthroline complex, *cis*-bis(4,7-dicarboxy-1,10-phenanthroline)dithiocyanato ruthenium(II) ($Ru(dcphen)_2(NCS)_2$), which has absorption properties due to MLCT transition with a maximum near 520 nm, similar to N3 dye, has been synthesized and characterized [111, 115, 117], and an efficiency value of 6.1 to 6.6% under AM1.5 was obtained using a nanocrystalline TiO_2 solar cell. It has been reported that a Ru bipyridyl complex having an acetylacetonato ligand instead of two thioisocyanato ligands (-NCS) also showed high performance as a photosensitizer [118]. A Ru biquinoline complex, whose absorption due to MLCT transition is red-shifted compared to that of N3 dye, has also been synthesized [114]. Because the LUMO level of this complex is not sufficiently negative to inject electrons effectively, high solar cell performance has not been obtained with a nanocrystalline TiO_2 electrode, although electron injection from this complex into a nanocrystalline SnO_2 electrode, whose conduction-band level is more positive than that of TiO_2, occurs effectively [114]. Tuning of both the LUMO and the HOMO levels of the complex to inject electrons effectively into the conduction band