Fluorescence spectroscopy is one of the most powerful tools for characterization of a multitude of biological processes. Of these, the phenomenon of protein oligomerization attracts especial interest due to its crucial role in the formation of fibrillar protein aggregates (amyloid fibrils) involved in ethiology of so-called protein misfolding diseases. It is becoming increasingly substantiated that protein fibrillization in vivo can be initiated and modulated at membrane-water interface. All steps of membrane-assisted fibrillogenesis, viz., protein adsorption onto lipid bilayer, structural transition of polypeptide chain into a highly aggregation-prone partially folded conformation, assembly of oligomeric nucleus from membrane-bound monomeric species and fiber elongation can be monitored with a mighty family of fluorescence-based techniques. Furthermore, the mechanisms behind cytotoxicity of prefibrillar protein oligomers are highly amenable to fluorescence analysis. The applications of fluorescence spectroscopy to monitoring protein oligomerization in a membrane environment are exemplified and some problems encountered in such kinds of studies are highlighted.