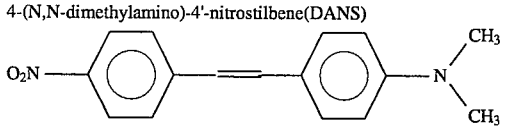
dissolved in a polymerizing material. Preferably, the fluorophore is selected from the class of fluorophores of the present invention, which are described in greater detail below. The change in peak fluorescence wavelength of the fluorophore is then measured during polymerization. The results are plotted as a function of cure time and a correlation is established between the wavelength shift and the extent of cure. Once this correlation is established, an absolute value for the extent of cure can be obtained from the measured value of the wavelength shift. Alternatively, the measured value of the wavelength shift can be used to compare or maintain the extent of cure throughout a manufacturing or clinical process. Thus, the method is especially advantageous for in situ, non-destructive cure monitoring because it eliminates the need for an internal standard fluorophore which is usually required in methods based on measurement of fluorescence intensity change. Further, the method does not require a complex optical system based on measurement of fluorescence anisotropy change.

The method of the invention is also useful for measurement of the extent of solidification (or cooling) of a thermoplastic polymer. The peak fluorescence wavelength of a fluorophore which is dissolved in a thermoplastic polymer decreases with decrease in the mobility of polymer segments (or the decrease in the free volume). Consequently, as the molten thermoplastic polymer cools and its segmental mobility decreases, the peak fluorescence wavelength of the fluorophore monotonically decreases. Therefore, once the calibration relationship between the peak fluorescence wavelength and the extent of solidification, as well as the onset of solidification, of the polymer is established by experiments, the peak fluorescence wavelength of the fluorophore can be measured during the processing of the polymer by injection molding to detect its solidification. Thus, measurement of peak fluorescence wavelength permits the adjustment of the injection molding cycle so that the mold is opened and the product ejected at optimum times. Opening the mold too soon will result in warping of the product shape, while allowing the product to remain in the mold too long will result in decreased productivity.

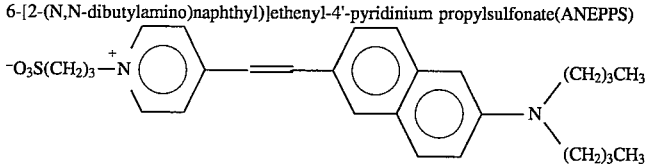
FIG. 1 shows the results of monitoring peak fluorescence wavelength of DMA-DPH in a stoichiometric mixture of diglycidyl ether of bisphenol A ("DGEBA") and diethylene triamine at 50° C. in accordance with the method of the invention. Specifically, the results are shown as a plot of peak fluorescence wavelength (triangles) and fluorescence intensity (circles) versus cure time. As is shown in the graph, peak fluorescence wavelength decreased rapidly and then decreased slowly after the cure time of 50 minutes. The peak fluorescence wavelength remained practically unchanged after the cure time of 160 minutes. The overall decrease in the peak fluorescence wavelength was 30 nm.

While the fluorophore DMA-DPH may be utilized, the fluorophores used in the method of the invention are preferably selected from the class of fluorophores of the invention, which include compounds comprising substituted linear alkenes having an electron accepting group and an electron donating group. Preferably, the electron accepting group is attached at the alpha position and the electron donating group is attached at the omega position of the linear alkene. The substituted linear alkenes include derivatives of ethylene, butadiene, hexatriene, and homologous higher conjugated linear alkenes. The electron accepting group is preferably one of the following groups: 4-pyridinium alkylsulfonate; and para-substituted phenyl, 1-naphthyl substituted at the 5-position and 2-naphthyl substituted at the 6-position, with the substituent groups chosen from the nitro, sulfoamido, sulfonate, cyano, acyl and carboxylic ester groups. The electron donating group is preferably one of the following: 4-(N,N-dialkylanilino), 6-[2-(N,N-dialkylamino)naphthyl] and 1-[5-(N,N-dialkylamino)naphthyl]. Among the most preferred fluorophores are the following:

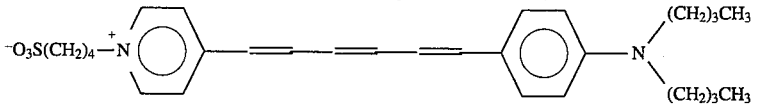
4-(N,N-dimethylamino)-4'-nitrostilbene(DANS)



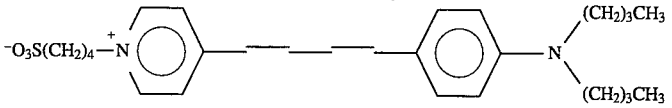
6-[2-(N,N-dibutylamino)naphthyl)]ethenyl-4'-pyridinium propylsulfonate(ANEPPS)



4-(N,N-dibutylanilino)hexatrienyl-4'-pyridinium butylsulfonate(AHPBS)



4-(N,N-dibutylanilino)butadienyl-4'-pyridinium butylsulfonate(ABPBS)



4-(p-dihexylaminostyryl)pyridinium propylsulfonate(DHASP-PS)