

Quenching of a Cyclohexane-*p*-Terphenyl Scintillator by Electron Scavengers

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Many studies have been made of the scintillation of liquid organic solutions induced by γ -rays in order to gain insight into the mechanism of energy transfer from the irradiated solvent to a scintillator compound.¹⁾ Cyclohexane containing a small amount of *p*-terphenyl is a typical scintillator system. Possible mechanisms of the energy transfer occurring in the system have been discussed by several investigators, but no definite conclusions has yet been reached.²⁾

On the other hand, recent studies of the γ -radiolysis of hydrocarbons have revealed that electrophilic compounds, such as nitrous oxide, carbon dioxide and sulfur hexafluoride, behave as electron scavengers in the system.³⁾

We have measured the scintillation from γ -irradiated cyclohexane containing a small amount of *p*-terphenyl in the presence of electron scavengers. The results are shown in Fig. 1. Obviously, the electron scavengers used do quench the scintillation from an irradiated cyclohexane-*p*-terphenyl solution.

A possible explanation for this observation is as follows. *p*-Terphenyl molecules capture electrons in the solution⁴⁾ and scintillate when they are neutralized. In the presence of electron scavengers, competition for electrons occurs and, as the overall result, a quenching of the scintillation is observed.

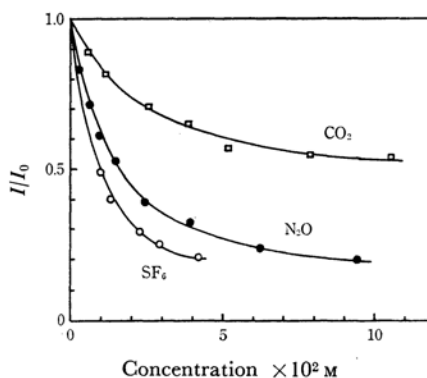


Fig. 1. Quenching of the scintillation from cyclohexane solutions of 8.4×10^{-5} mol/l *p*-terphenyl as a function of the concentration of electron scavengers at room temperature.

When carbon dioxide is used as a quencher, the situation seems to be more complex. The incomplete quenching by carbon dioxide of 0.1 mol/l can, however, be tentatively explained in terms of the participation of the charge transfer from CO_2^- to *p*-terphenyl.

Experimental

1 mCi Co-60 sealed in a glass tube was attached to the window of a quartz vessel, in which a deaerated cyclohexane solution of *p*-terphenyl was sealed with or without electron scavengers. The scintillation from the solution was measured with a photomultiplier (MS-9SY supplied by Toshiba Co.) and recorded. The solubilities of electron scavengers in cyclohexane have been reported previously.³⁾

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