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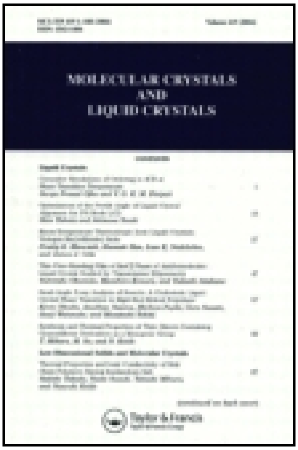

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The Influeyice of Gamma Radiation on the Liquid-Crystalline Properties of Cholesterol Esters

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THE INFLUENCE OF GAMMA RADIATION ON THE LIQUID-CRYSTALLINE PROPERTIES OF CHOLESTEROL ESTERS

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Abstract The influence of gamma radiation with different parameters on the phase transition temperatures of cholesterol esters was studied. They lowered linearly with exposure dose in wide range of doses and became non-linear for sufficiently high doses. The observed effects were higher for the radiation with lower energy.

INTRODUCTION

The influence of ionizing radiation on mesogenic materials is interesting both from fundamental and practical point of view. The latter includes: the limitation of LCD use in the fields of ionizing radiation, dosimetry applications and the effect of ionizing radiation on liquid-crystalline tissues. There are only few works concerning this subject[1-3].

EXPERIMENTAL

The choice of cholesterol derivatives as the mesogens has been caused by the possibility of determining the effect of

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molecular properties on the observed effects (only one substituent has been changed) and predicted low radiation stability of these compounds. As the radiation sources the Co-60 and Cs-137 sources and X-ray generator with mean energy about 200 keV have been used. The phase transition temperatures have been measured by the polarizing microscope with heating stage. The results have been plotted on ΔT_p vs D_e graphs, where $\Delta T_p = T_p^O - T_p^D$ was the change of phase transition temperature caused by the exposure dose D_e. For the linear range of these characteristics the dose sensitivity

$$\eta = \frac{\Delta T_p}{D_e}$$

was calculated. The experimental error was 5-15 per cent.

RESULTS AND DISCUSSION

The example of obtained results is presented on Fig.1. All results are collected in Table I. The phase transition temperatures lowered with exposure dose linearly up to $5 \div 8 \times 10^3$ C/kg. **For higher doses this relationship was non-linear.** The most sensitive to exposure dose was T_{Ch-I} and comparably T_{S-Ch}. The shorter molecular length of cholesterol derivative the higher ΔT_p value for the same exposure dose. It can be understood in terms of Martire's theory of influence of admixtures on phase transition temperatures[4]. In our case the admixtures are the radiolysis products of cholesterol derivatives, preferably cholesterol and fatty acid or halogen derivative. The smaller gamma radiation energy the larger ΔT_p (about 5% on 100 keV). There was no relationship between ΔT_p and dose rate in the range of 0.05 - 1 A/kg. The dose sensitivity values for the mixtures of cholesterol derivatives were 3-4 times greater than for individual compounds. In these cases more possibilities of radiation reactions exist.

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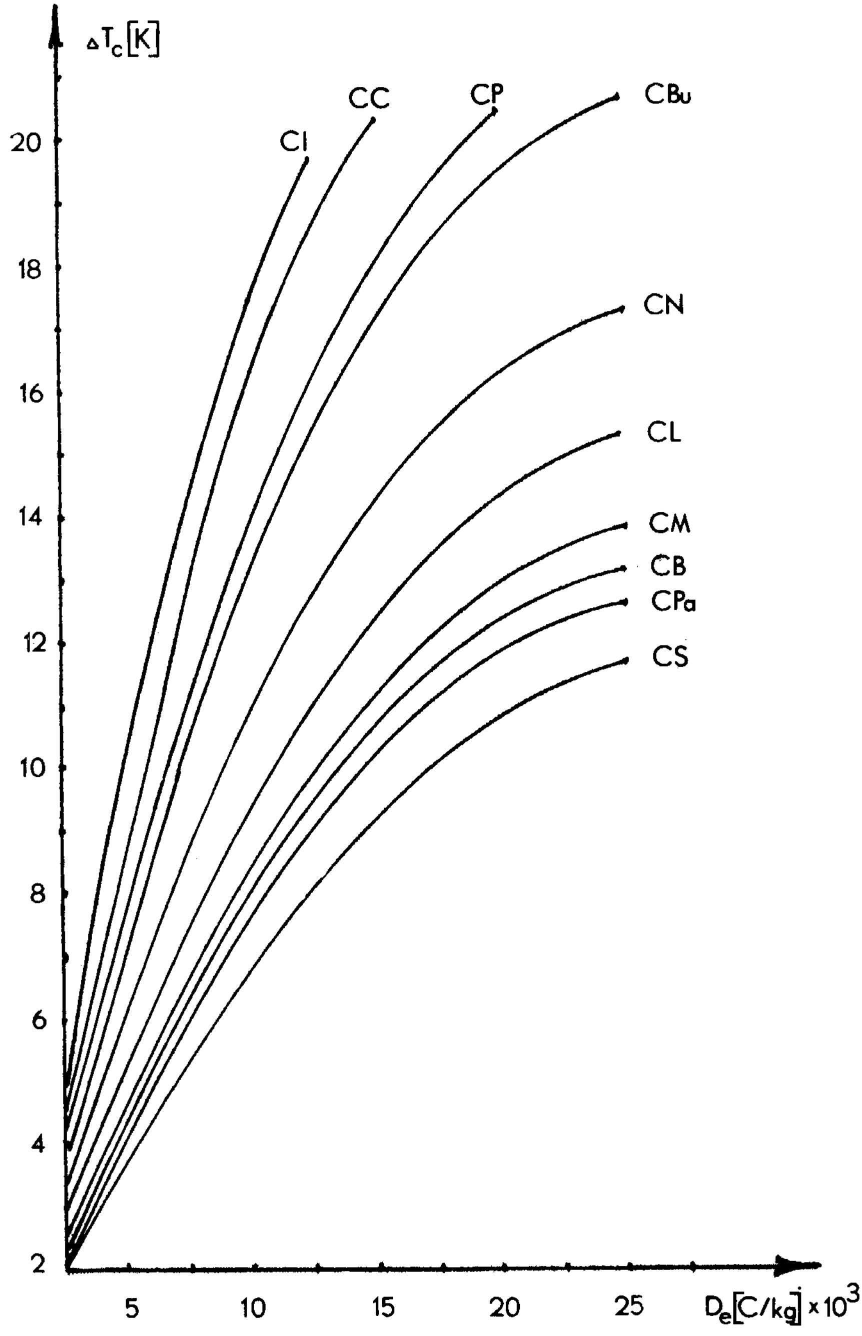

FIGURE 1 Dependence of the Ch-I transition temperature of studied compounds on the absorbed dose for Co-60 source

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TABLE I GAMMA RADIATION STABILITY OF STUDIED CHOLESTEROL DERIVATIVES

Cholesterol derivative		Phase vanishing dose [C/kg] x 10^4 S	Phase vanishing dose [C/kg] x 10^4 Ch	[K kg/C] x10^{-2} Co-60 S	[K kg/C] x10^{-2} Co-60 Ch	[K kg/C] x10^{-2} Cs-137 S	[K kg/C] x10^{-2} Cs-137 Ch
iodide	CI	-	1	-	2.0	-	2.2
chloride	CC	-	1.5	-	1.72	-	1.92
propionate	CP	-	1.75 (2.0)	-	1.52	-	1.64
butyrate	CBu	-	1.75 (2.25)	-	1.48	-	1.60
walerate	CW	-	1.75 (2.25)	-	1.44	-	1.56
nonanoate	CN	(1.25)	1.25 (2.50)	1.20	1.32	1.25	1.36
laurate	CL	(2.50)	(2.50)	0.90	1.02	0.95	1.08
mirystate	CM	0.5 (1.25)	1.5 (2.50)	0.86	0.92	0.90	0.95
palmitate	CPa	(2.0)	0.75 (2.25)	0.80	0.84	0.85	0.88
stearate	CS	(2.5)	(2.5)	0.68	0.72	0.70	0.75
benzoate	CB	-	2.5	-	0.88	-	0.92
oleyl carbonate	COC	1.5	1.5 (2.5)	1.40	1.55	1.48	1.60

x monotropic transitions are given in parentheses

The cholesterol derivatives have rather great radiation stability. The reported values of η relate to solid irradiated samples. For the samples irradiated in liquid-crystalline or isotropic state these values were higher.

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