EFFECT OF ROTATION OF STEROID MICROCRYSTALS IN NEMATIC DROPLET

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S u m m a r y

It has been found that a number of chiral steroid biomolecules (vitamin D isomers and related compounds) induce the cholesteric phase when adding to nematic liquid crystals (LCs) [1, 2]. To obtain the cholesteric phase, we dissolved a steroid substance in nematic LCs, and a typical 'fingerprint" texture was observed with a polarized microscope as a result of dissolution. The value of the cholesteric pitch and the helix sign are measured by the Cano – Grandjean method using wedge-like LC cells [9]. Surprisingly, we found that steroids with rigid skeleton (cholesterol, 7-dehydrocholesterol (7-DHC), lumisterol $_3$ and ergosterol) possess the lower helix twisting power (HTP) than vitamin D_2 (ergocalciferol) with its flexible molecular structure [7]. In all cases, cholesteric helices were left-handed except provitamins D_3 and D_2 (7-DHC and ergosterol), which induced right-handed helices [3, 4]. What is the most interesting, we have first observed the effect of rotation of a single steroid microcrystal during its dissolution at room temperature in a nematic droplet (ZLI-1695). While the steroid crystals have different shapes depending on the crystallization conditions (needle-shaped, prismoidal, or disk-shaped), the rotation effect was observed only in case of a single needle-shaped or prismoidal microcrystal of $0.1 \div 1$ mm in length. Rotation was uniform, and the angular velocity was equal 6 degree/s in case of a 7-DHC microcrystal. It is particularly remarkable, that, for all the compounds, the correlation was observed between the rotation direction and the sign of the induced cholesteric helix. Namely, for provitamins D_3 and D_2, which induced a right-handed helix, the rotation was observed in the clockwise direction, whereas for the other steroids, which induced left-handed helices, rotation occured in the counter-clockwise direction. It must be emphasized that rotation was observed neither in the isotropic phases of LCs nor in a viscous solvent while, in case of a more viscous LC (ZhK-805), rotation appeared only upon heating up to 60 ℃. We think the origin of the effect revealed is attributable to the known Lehmann's effect [10] associated with thermomechanical interactions in cholesteric crystals. However, we believe that the crystal rotation in an LC droplet is initiated by chemical potential, and the concentration gradient plays the same role as the temperature gradient in the Lehmann's effect. In conclusion, it may be said that, under close examination of the cholesteric phase induction by steroids, we pioneered the observation of a direct transformation of the dissolution chemical energy into the mechanical energy of rotation.