

Spatial pattern formation of a cholesteric liquid crystal under rapid temperature change.

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We have found that a cholesteric liquid crystal, cholesteryl oleyl carbonate, forms a peculiar spatial pattern under a rapid temperature change. The pattern is like a two-dimensional network connecting round black parts in the size of several microns by bold wires having the thickness in a similar size and the length of 10-20 microns. This network is easily observed by a microscope since it has a different color from the other background part which reflects light selectively by the helical structure of the cholesteric liquid crystal. The pattern formation occurs only when the sample is heated faster than 1 mK/s, while the uniform pattern is maintained under lower rate of temperature rise.

Further, we have performed spectroscopic experiments during this pattern formation process and found that the transmission spectrum has two additional components besides the original peak which is caused by the reflection due to the helical structure in equilibrium state. One additional component is located in shorter wavelength than that of the original helical structure. The other component appears as a background which gradually increase as wavelength decreased.

It is considered that the re-construction of helical structure cannot follow the rapid temperature change and the peculiar pattern is produced to lower free energy as the whole system. In this paper, we will present the experimental results in detail as a new example of the pattern formation under non-equilibrium state and discuss the mechanisms of the formation process using a phenomenological model.