Experimental Study of stable phase jump lines in twisted nematic

Dept. of Physics, Univ. of Tokyo　Soichi Tatsumi[1], Masaki Sano

Yokohama National University　A. G. Rossberg

パターン形成に対する理解はその普遍性にも関わらず、重要な問題であり続けてきた。ある種のパターン形成においては、出来上がったパターンの持つ不安定性を引き金にして更に高次のパターンを作りだす事もある。そのような種類のパターン形成において、パターン中に出来る欠陥が大きな役割を果たすと考えられる。私達はねじれ配向させた液晶 (MBBA) を用い、その時に作りだされる特殊な欠陥が、実際にそのような現象を引き起こすことを発見し、現象論的なモデルを通しそのことを確認した。

1 Introduction

We could see various kinds of pattern formation in many fields. Its mechanism, however, is still challenging problem for us. One of the typical question for this is stability of appearing pattern. We could see the appearing pattern shows some kind of instability and changes to the high degrees of pattern formations. In this type of pattern formation, the dynamics of defect in appearing pattern is thought as very important. In our study, through observing electroconvection in twisted nematic(MBBA), we could get clear results for this type of pattern formations and found its results are well agree with phenomenological model.

2 Experiments

The cell we are using is whose lateral extensions are 2cm × 2cm and thickness is $d = 50\mu$m. And we filled it MBBA doped with 0.1wt% tetra-n-butylammonium bromide. Temperature of the cell was controlled at 25 ± 0.01 ℃. A standard wave-generator was used to apply ac voltages $V = \mathcal{O}(100\text{V})$ of frequencies f up to several kHz to the cell. The anchoring direction of the liquid crystal sets perpendiclular between upper and lower plate[2].

From such a setup, besides the well-known states, we could find stably aligned phase jump lines (PJL) in a wide frequency range of the conductive regime(Fig.1). This pattern regard as

[1]E-mail: tatsumi@daisy.phys.s.u-tokyo.ac.jp

[2]In detail, please see cond-mat/nlin.PS/0412002[1]

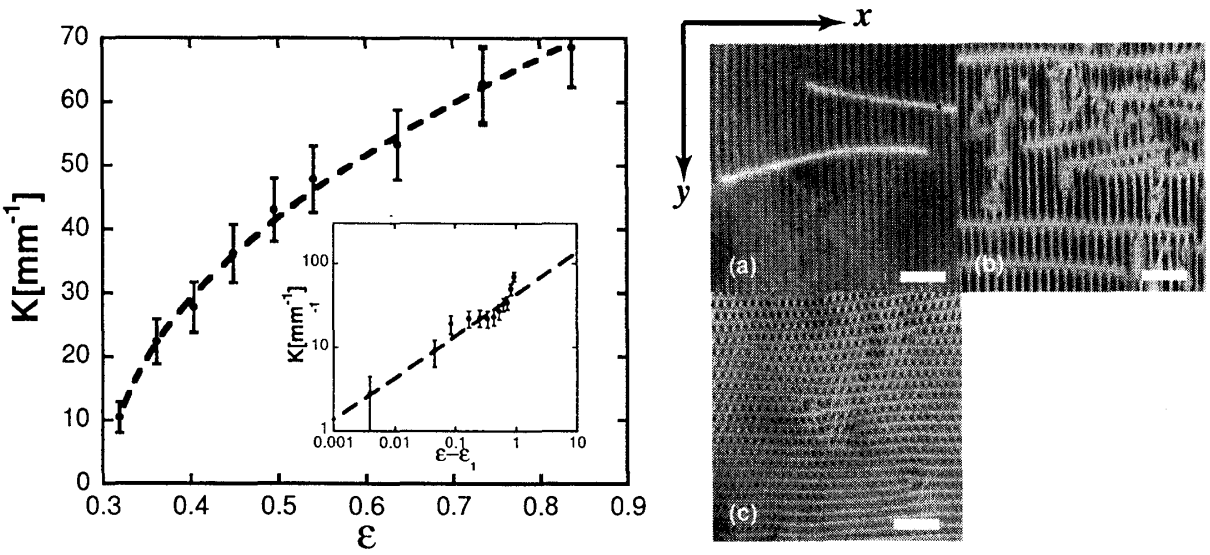

Figure 1: The right side figure shows the defraction images of convection patterns with PJL. These figures represent the transition from PJL to GP. Fig. a corresponds to 13.93 V($\epsilon = 0.47$), Fig. b to 15.91 V ($\epsilon = 0.91$), and Fig. c to 19.23 V ($\epsilon = 1.79$), all at 400 Hz. The length of the scale bars is $200\mu m$. The left side figure represents the relation between wavenumber of PJL and ϵ at 400Hz.

the line-defect in convection roll. As the voltage is increased, the density of its structure becomes high, and it makes square pattern like PJL-grid. We show this schematic structure in Fig.1. We could see from this figure, the wavenumber of PJL[3] following a square-root law to ϵ.

3 Conclusion

We could understand the stabilization of PJL as the effect of twisted geometry theoretically. And also we could understand the coupling of zig-zag modulation with this pattern makes the PJL-grid. This is a typical example of "sequencial pattern formation". In this case, defect in the pattern makes the next pattern formation.

References

[1] Soichi Tatsumi, A. G. Rossberg and Masaki Sano cond-mat/nlin.PS/0412002

[3]It corresponds to the distance between PJL.