論文 / 著書情報
Article / Book Information

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Title(English)	
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学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

方向
（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	物性物理学	専攻	
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申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	（ 理学 ）
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要旨（英文800語程度）
Thesis Summary (approx.800 English Words)

This thesis is titled as "Development of a high-resolution differential scanning calorimeter and study of phase transitions in antiferroelectric liquid crystals using the new calorimeter". The thesis contains two main components. The first one is the development of a high-resolution differential scanning calorimeter (DSC). The other is calorimetric investigationson the antiferroelectric liquid crystals (AFLCs) using thus developed highresolution DSC.

The demands for high sensitive calorimetric measurements are rapidly growing among various fields in order to analyze small heat anomaly. Such situation is all the more significant in the study of AFLCs. In chapter 1 of this thesis, after a short review of phase transition behaviors in AFLCs, it is pointed out that high-resolution calorimeters are especially needed because of some features that the phase transitions of AFLCs exhibit. In particular, many of those transitions are of the first-order, with latent heats which are quite small, and accompany almost no pre-transitional heat anomalies. It has also been stressed that thermal measurements are advantageous in the sense that they are sensitive to all degree of freedom relating to the phase transition.

In Chapter 2 of the thesis, several methods of thermal measurements which have been used in the study of liquid crystals are listed up, and their merits and demerits are compared. Chapter 3 of the thesis describe details of construction of a highresolution DSC, to meet with the requirements mentioned above. The combination of high density thin thermo-electric sensors and CVD diamond heat-spreader achieved quite high sensitivity and quick relaxation time. As a result, a sensitivity of 5 nW, and a relaxation time of 1.4 s have been obtained. Some examples of measurements which prove the effectiveness of the high sensitivity DSC are also briefly shown.

Chapter 4 corresponds to the second part of the thesis, focusing on the heat capacity measurements with the high sensitivity DSC, and also with an ultralow frequency ac calorimeter, carried on several AFLCs. The measurements have revealed that all phase transitions among chiral Sm-C phases, except for the SmCα-SmC transition, are always first-order. These transitions exhibit a delta function-like heat anomaly with almost no thermal fluctuation effect, and with distinct thermal hysteresis. It was shown that these results can be explained in terms of symmetry change in phase transitions. On the other hand, the SmCα-SmC transition changes its nature depending the temperature width of SmCα phase. Such behavior has been explained as the effect of coexisting fluctuation due to the transition to the SmA phase. In particular, it was found that the optical impurity play a role of an effective field which drives the the SmCα-SmC transition from first-order to supercritical behavior through an isolated critical point. Quantitative analyses of the critical behavior at this critical point were also done. The results revealed that it does not fit in any known universality class, strongly suggesting that it should be related to a new universalityclass proposed by the theory for critical points in layered systems.

In Chapter 5, summary and concluding remarks are given. In the present study, a high-resolution DSC has been successfully constructed. It has provided precise data for phase transitions in AFLCs. Those data were found to be quite helpful to understand detailed natures of the transition, and also serve to stimulate further experimental and theoretical investigation in this field.

備考：論文要旨は、和文2000字と英文300語を1部ずつ提出するか、もしくは英文800語を1部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).