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Author(s)	Endo, Hitoshi
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Study on Multicomponent Systems by Means of Contrast Variation Small Angle Neutron Scattering

Hitoshi Endo

*Institute for Solid State Physics, The University of Tokyo¹
Research Fellow of the Japan Society for the Promotion of Science*

多種多様な相互作用が存在し得る多成分系においては、相互作用が選択的に働く事により特異な物性が発現する場合が多々存在する。中性子散乱では、軽水素と重水素を化学的に置換することにより、物理的な性質にほとんど影響を与える事無く散乱コントラストを変化させる「コントラスト変調法」が可能であり、この手法を精密に適用する事で、多成分間の相互作用を cross term として定量的に観測する事が可能となる。本研究においては、両親媒性高分子が水/油/界面活性剤マイクロエマルジョン中で引き起こす効果や、タンパク質がリン酸カルシウムの結晶化を阻害する効果に対し、コントラスト変調中性子小角散乱法を用い、系内で織りなされる複雑な相互作用を分子論的に解明した。

Multicomponent systems are of great interest because of their rich variety of structures, complexities, etc. With neutrons as probe, contrast variation techniques based on H/D replacement can be used to modify the visibility of different components in the system. Moreover, the fine application of the contrast variation may lead to decompose the scattering signals into partial scattering functions, which allows us to evaluate each component in detail. Especially, the cross terms can be achieved by means of this technique, which directly reflect the interaction of the corresponding two components.

In this presentation, two concrete experimental results of studying multicomponent systems will be introduced: the first example is "boosting effect of amphiphilic block copolymer on water/oil/surfactant microemulsions" [1], and the other one is "inhibition of calcium phosphate deposition by fetuin-A/ α_2 HS-glycoprotein" [2]. In both cases, the minute addition of polymers/proteins induces dramatic effect on the system. Sophisticated contrast variation small angle neutron scattering technique was applied in order to explore the role of the polymers/proteins. Our method was accurate enough to identify the structures of multicomponent systems, and the achieved information of cross terms led to conclude the role of the polymers/proteins.

We will present our observation in detail as well as the experimental recipe.

References

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¹E-mail: hit-endo@issp.u-tokyo.ac.jp