SINGLE DIAMOND STRUCTURE IN DIBLOCK COPOLYMER SOLUTION

Itsuki Saito[a], Akifumi Matsushita[a], Shigeru Okamoto[a]

[a]Department of Materials Science and Engineering, Nagoya Institute of Technology (Gokiso-cho, Showa-ku, Nagoya, 466-8555, Japan, okamoto.shigeru@nitech.ac.jp)

ABSTRACT

Block copolymers (BCPs) have attracted great attention as a promising material for photonic crystals because they can self-assemble to form various periodic structures. It is predicted that some structures, single gyroid, single primitive and especially single diamond, possess large photonic band gaps[1]. However, it is exceedingly difficult to form these structures with BCPs.

The addition of a selective solvent to BCPs can expand the range of accessible self-assembled morphology. In this research, two selective solvents and one common solvent were used. For a BCP, we used Polystyrene-*b*-Polyisoprene (PS-*b*-PI) (M_w=7.2×10^4, PDI=1.04, f_{PS}=0.45), hereafter denoted as SI0927. Solutions were prepared with dimethyl phthalate (DMP) as a selective solvent for PS phase, *n*-tetradecane (C14) as a selective solvent for PI phase and diocthyl phthalate (DOP) as a common solvent. To study structures, we performed small angle X-ray scattering (SAXS) measurement at BL40B2 in SPring-8 and BL8S3 in AichiSR, Japan. SAXS profiles we obtained from the solutions at various ratios of SI0927, DMP, C14 and DOP showed that various self-assembled morphologies such as lamella, BCC, FCC and gyroid were formed. More interestingly, we obtained one SAXS profile shown in Figure.1. The peak positions relative to the first one strongly indicate a single diamond structure. This is the first discovery of a single diamond structure in diblock copolymer systems.

In bulk systems, packing stress becomes higher than solution system. Thus single diamond structure has not been formed in bulk system.

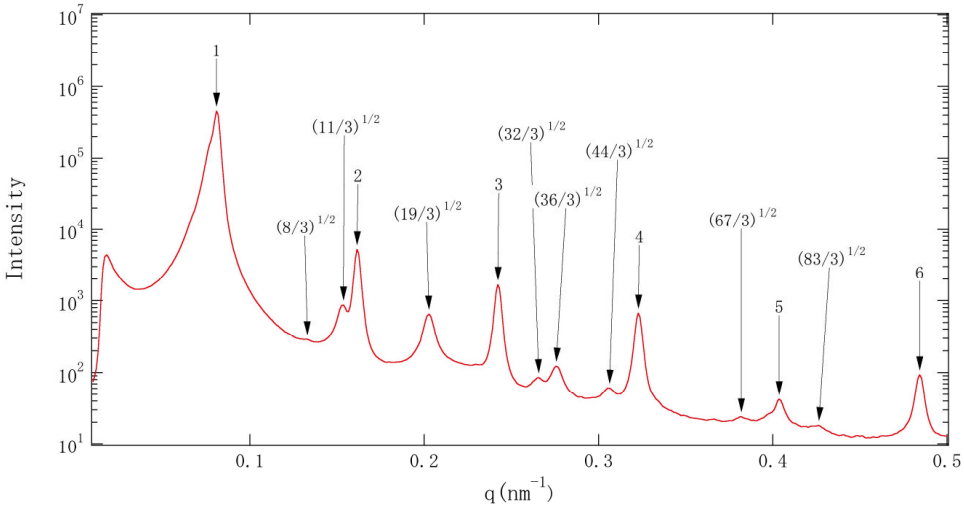

Fig.1: SAXS profile of a single diamond structure in the solution composed of SI0927/DMP/C14/DOP=20/38.4/25.6/16

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References :

[1]Maldovan, M.; Carter, W. C.; Thomas, E.L. *Appl. Phys. Lett.* **2003,** *83*, 5172