SP3.01

Preparation of Graded-Index Plastic Optical Fiber by Co-extrusion Process

*Ryoma Hirose (a)(b), Makoto Asai (a)(b), Astushi Kondo (b), Takaaki Ishigure (a)(b), Yasuhiro Koike (a)(b)

(a) *Faculty of Science and Technology, Keio University, Japan*
(b) *Japan Science and Technology Agency, SORST, Japan*

Poly(methyl methacrylate) (PMMA) based graded-index plastic optical fibers (GI POFs) are expected to be a medium for very-short-reach networks because its large core diameter and great flexibility allow an easy network installation. In this paper, a novel preparation method of GI POFs called 'co-extrusion process' is proposed. Compared with the conventional method (preform method), manufacturing cost could be remarkably reduced by the new method. In the co-extrusion method, PMMA homopolymer (for cladding) and doped PMMA that has higher refractive index (for core) are fed into a die, then, a concentric core-cladding structure is formed. Here, the dopant is an aromatic compound. Subsequently, the dopant in the core region diffuses into the cladding layer. Thus, a parabolic refractive index profile in radial direction is formed. By controlling the extruding temperature, the diffusion conditions (i.e., the diffusion temperature, the diffusion time), and the molecular weight of PMMA, a PMMA-based GI POF is prepared for the first time by this method. The refractive index profile obtained by this method has been estimated to show a tailing at the core-cladding boundary, which is a typical profile obtained by Fickian diffusion. The bandwidth degradation by the tailing in the index profile has been of a concern. However, it is confirmed experimentally that the GI POFs with refractive index profiles without tailing can be obtained even by the co-extrusion method under appropriate diffusion conditions. As a result, the refractive index profile that is precisely fitted to the power-law profile with an index exponent g=2.7(optimum g=2.49) is obtained by adjusting the diffusion condition. It is indicated that the GI POF obtained by the co-extrusion process is expected to have a high-bandwidth similar to the one prepared by the conventional interfacial-gel polymerization method.