

Status of Photonics Polymers for High-Speed and High-Quality Communication Technologies

Y. Koike

Faculty of Science and Technology, Keio University 3-14-1 Hiyoshi, Kohoku-ku, Yokohama City, 223-8522 Japan; koike@appi.keio.ac.jp

We learn from history that the innovations of technologies that dramatically changed the world were, in many cases, achieved by innovations from material side. For example, in 1960s, the role of the vacuum tube was ended by the invention of semi-conductor material (transistor) that opened the door to the real electronics society. In 1990s, CRT television was replaced by liquid crystal display (LCD) by the invention of liquid crystal molecules. These are examples that show that “the innovation in materials changed the system”. Such a novel function of materials has been created by “the nanotechnology of material”.

Based on fundamental research for more than thirty years on the correlation between polymer structures and photonic phenomena, we have proposed novel photonics polymers based on nanotechnologies, such as Graded-Index Plastic Optical Fiber (GI POF)^{1,2}, Highly Scattered Optical Transmission (HSOT) polymer, and zero-birefringence polymer. Control of the refractive index distribution radially within the fiber core in dimensions of hundreds of thousands nanometer led us to propose the world’s fastest GI POF covering 40 Gbps data transmission. Utilizing the specified scattering phenomena by controlling the dimensions of thousands nanometer heterogeneities in polymer, the HSOT polymer for a much brighter display compared with conventional transparent backlight was proposed and is now commercially used in PC backlights such as in SONY VAIO etc. Birefringence seriously degrades color uniformity in displays and is a persistent demerit of polymer materials, which is easily caused by nanometer-sized anisotropic structures of polymers appearing when the polymer is oriented. The idea of compensating for this anisotropic structure in the dimension of nanometer led us to propose the zero-birefringence polymer, which has dramatically improved the color uniformity of LCD³.

By connecting ultra-high speed GI POF possessing super-high bit-rates to high quality displays, an overwhelmingly sensational real time face-to-face communication is achieved. The key to this development is the photonics polymer based on nanotechnology, which is expected to totally change what we accept today as means of communications.

References

1. Y. Koike, *Fundamentals of Plastic Optical Fibers*, 2014, Wiley-VCH, Berlin, 400 pp., ISBN: 978-3-527-41006-4.
2. Y. Koike and A. Inoue, High-Speed Graded-Index Plastic Optical Fibers and Their Simple Interconnects for 4K/8K Video Transmission, *J. Lightwave Technol.*, 2016, **34** (6), 1551-1555.
3. Y. Koike, "Overwhelmingly Realistic Face-to-Face Communications: Photonics Polymer Technology," Keynote Speech, SID2011, Los Angeles, CA, USA, May 15-20, 2011