



Analytical studies for development of liquid crystal displays and organic light-emitting diodes

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Abstract

Overview of part of analytical studies on liquid crystal displays (LCDs) and organic-light-emitting diodes (OLEDs) is presented. In-plane switching (IPS)-LCDs have successfully been developed and have practically been used as today's standard LCD mode for LCD-TVs, smartphones and tablets. Many frameworks on the IPS electro-optical effect have been accomplished theoretically and experimentally such as how LC molecules statically and dynamically respond to in-plane electric field, how the cell parameters and molecular properties affect the response to the field. Along with the understandings of device physics, an innovative concept for optimization of LC materials suited for the IPS effect has been established and new LC mixtures have practically been developed.

Growing interest in research also extends to fundamental questions on how and why LC molecules are aligned at the surface of rubbed polymers. Sum-frequency vibrational spectroscopy (SFVS) has been used to study the molecular orientations at various polymer surfaces for LC alignments. SFVS has successfully proven to be such a powerful and versatile technique that we can analyze various molecular orientations at the surface. Various molecular orientations appear at the surface depending on various types of polymer materials and surface treatments.

OLED is one of the high-profile candidates for the next-generation displays, competing with well-established and still rapidly evolving LCD technologies. Although OLED displays are allegedly ready to the market, many issues still remain unsolved. As one of the approaches to tackle the issues, SFVS has also been applied to the research field of OLED. Analyzing molecular orientations in organic thin films was one of the hot issues in the field of OLED, but the techniques for analysis had been limited to linear optics at the time. For the first time, SFVS was successfully used to demonstrate detailed molecular orientations in an organic thin film used for OLED. With the help of these kinds of the current and previous studies, as research plans for the near future, our desired missions are to build frameworks that sustain display industry for the next generation displays from the viewpoints of materials science and to play a role as interface between academia research and practical industry in Taiwan.

Biography

Prof. Masahito Oh-e was born in Japan. He received MS degree from Tokyo Institute of Technology in 1989 and subsequently entered Hitachi Research Laboratory of Hitachi, Ltd. He was involved in R&D for LCDs and successfully made many frameworks on In-Plane Switching (IPS)-LCDs, which provide extremely good viewing angles. He received Ph.D. from Tokyo Institute of Technology in 1998. From 1998 to 2001, he stayed in University of California at Berkeley as a postdoctoral visiting research scientist, studying surfaces and interfaces by nonlinear optical spectroscopy. In 2002, he then joined Japanese governmental projects: Yokoyama Nano-structured LC Project and LC Nano-system Project. From Oct. of 2009 to Sept. of 2015, he worked as Department Director and Chief Technical Research Fellow in Sharp Labs of Tokyo, Sharp Co. In Sept. of 2016, he started working as professor in Institute of Photonics Technologies, Department of EE in National Tsing Hua University.