Slippery Interfaces — Reduction of driving voltage of LCD by lubrication

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Anchoring effects on the polymer films in the liquid crystal (LC) display devices plays key role to create the restoring force to the black state for any types of display modes, such as IPS, STN, VA and OCB etc, However, the LC mode in chiral materials, such as deformed helix mode in SmC* (DH-FLC) or the polymer stabilized blue phase (PSChBP), can spontaneously recover black state by rewinding motion of the helix itself without surface anchoring on the glass substrates. We have invented the principle and design of slippery interfaces, which has zero anchoring force, and confirmed the drastic reduction of driving voltage in DH-FLC mode of SmC* (<1 order) keeping the fast switching response (<few 10 micro second). Proto-type of slippery interfaces in ferroelectric liquid crystal (SmC*) is formed by liquid phase made by the macroscopic phase separation due to the trans-cis isomerization of doped azo dye. We discuss the lubrication for the dynamics of the C-director rotation on the slippery interface.

On the contrary to the SmC*, in order to reduce the driving voltage of PSChBP, new mechanism is necessary to cover slippery interfaces automatically on the polymer rods in PSChBP. We propose new principle for designing the spontaneous slippery interfaces on the nano-scale interfaces based on the disorder effect. Isotropic liquid thin film is created by the surface melting effect due to the impurities with the affinity to the interface. We measured the anchoring energy and the surface viscosity of the director motion near anchoring transition temperature between anchoring and slippery states.

Speaker Biography

Jun Yamamoto received B.S. degree in Applied Physics from University of Tokyo in 1984, and M.S. and Ph.D. degrees in the same department in 1986 and 1990, respectively. Since 1987, he has been with the Department of Applied Physics for the assistant professor, University of Tokyo, the moved to Institute of Industrial Electronics Engineering. From 1999, he belongs to the ERATO nano-structured liquid crystal project of Japan Science and Technology Agency. Finally, he moved the department of physics in Kyoto University, Kyoto, Japan, where he is currently a full Professor. Prof. Yamamoto chaired the non-equilibrium soft matter in 2012, Japanese-Italian liquid crystal workshop (JILCW2016) in 2016. He also will co-chair the next International liquid crystal conference (ILCC2018) at Kyoto in 2018. He was awarded as Achievement award of Japanese Liquid Crystal Society in 2015.