Scaling of Defect Domain by Reverse Twist in Chiral Hybrid In-Plane Switching LC Mode

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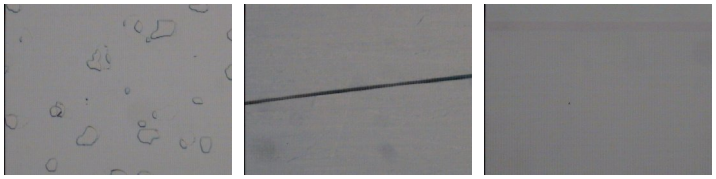
We have proposed a new liquid crystal (LC) display mode (CHI mode) which has the good dark state and removes a loss of transmittance on interdigitated electrode [1]. The structure is conventional hybrid mode which is coated with homogeneous and hometropic alignment layers on bottom and top substrate, respectively. We adopt the chiral dopant (S-811, Merck) to liquid crystal (ZKC-5085, Chisso) to be optimized to the normally white mode by using the twist effect. Compared to the conventional IPS mode, this mode can get the very good bright state without any loss of transmittance on the transmittance. This mode also can get the good dark state under relatively small electric field, because we just need to rotate the LC at bulk [2]. However, when LC is injected into sample, the domains by reverse twist are induced usually. When the voltage is applied to LC cell, disclination lines are generated gradually from the domain boundary. Due to this appearance, it is difficult to maintain the gray level.

In the result, it is important that the domains by reverse twist must be removed in CHI mode. In order to remove such a defect line, we examine LC injection temperature and LC injection direction that can regard as dominant factors to lead to the reverse twist domain.

As shown in Fig. 1, the LC injection at higher temperature than nematic-isotropic transition temperature (T_{NI}) of LC creates indiscriminately many and small domains. On the other hand, when the LC injection temperature is lower than T_{NI}, relatively large and few domains are generated evenly among all. By the way, we observed that these domains vanish by LC injection in the vicinity of T_{NI} of LC as shown in Fig. 1 (c). It shows that the LC injection (103°C ~ 113°C) in the vicinity of T_{NI} (108°C) of the LC used in our experiment does not nearly generate any domain. As another approach, it is well known that the direction of LC injection has influence on the surface alignment of LC. So when the LC is injected in the rubbing direction, the surface alignment of LC is better. Especially, the LC injection direction has large influence on the creation of domain in this mode. Consequently, when the LC is injected parallel to the rubbing direction of homogeneous LC alignment layer, we can obtain the better LC alignment state.

As a result, we find that the injection temperature and direction are important conditions which do not lead to defect domains. It is supposed that injection temperature has influence on the surface alignment of LC due to temperature-dependent interaction between LC with chiral dopant and surface alignment layer.



(a) (b) (c)

Figure 1. The configuration of domain at (a)130°C, (b)50°C and (c)108°C

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