Influence of etched silicon patterns on the liquid crystal orientation O4

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Liquid Crystals on structured surfaces have many applications. The structures can be used to obtain specific alignments, such as those required for bistable devices [1]. They can also appear in photonic components like waveguides with a variable phase delay.

We have demonstrated the effect of structures etched in Silicon-on-Insulator (SOI) wafers on the orientation of nematic liquid crystal. The patterns are defined by deep-UV lithography, a mass production technique. Fig. 1 illustrates the orientation of LC for a simple grating.

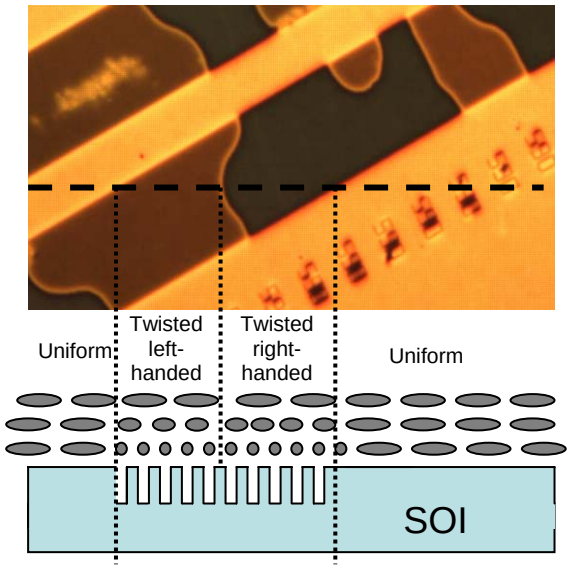

Fig.1 Top view picture and schematic cross section of a liquid crystal on a simple silicon structure. On top liquid crystal layer is a conventionally rubbed alignment layer, perpendicular to the grating. Whereas the layer is uniform above the flat surfaces, it splits up into two TN-like domains above the grating. (scale of the picture? Vertical/horizontal scales the same?)

We have characterized the alignment effect of different patterns, and found several configurations that allow bistable director orientations. The influence of surface treatments (deposition of a monolayer on the structured surface, e.g.) has been investigated. We examined the importance of the scale of the patterns, ranging from less than 100nm for integrated photonic waveguides to a few µm for display applications. The LC alignment near the patterns has been simulated numerically and good agreement with the experimental results was obtained.

[1] Kim J.-H., Yoneya M., and Yokoyama H., High-resolution bistable nematic liquid crystal device realized on orientational surface patterns, App. Physics. Lett. 83 (17), pp. 3602-3604, 2003

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