Study of the dispersion of refractive indexes in the visible, near, short and medium infrared regions of nematic liquid crystal mixtures for high-transmission light modulators with very low reflectivity

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A b s t r a c t

Accurate and quick determination of dispersions of isotropic $n_i(\lambda)$, ordinary $n_o(\lambda)$ and extraordinary $n_e(\lambda)$ refractive indices of Nematic Liquid Crystals (NLC) in domains of wave length λ in VISible (VIS) for $\lambda\in[0.4\mu m, 0.8\mu m]$, Near InfraRed (NIR) $\lambda\in[0.8\mu m, 1.4\mu m]$, Short-Wave InfraRed (SWIR) $\lambda\in[1.4\mu m, 3.0\mu m]$ and at the edge of Mid-Wave InfraRed (MWIR) $\lambda\in[3.0\ \mu m, 4.2\ \mu m]$ range is still unsolved problem.

Knowledge of the exact values of $n_e(\lambda)$, $n_o(\lambda)$ and optical anisotropy $\Delta n(\lambda)=n_e(\lambda)-n_o(\lambda)$ with absolute error δn not higher than $\delta n<0.02$ is absolutely necessary for the preparation of refractive index matched opto-electric transducers with high Transmission (T>97.5%) and what is more with extremely low light Reflection (R<0.7%).

In VIS region, when $n_e(\lambda)$ are smaller than 1.9 the dispersion of refractive indices of NLCs are measured easily (with $\delta n<0.0005$) by using appropriately prepared Abbe refractometers for given λ.

In VIS and NIR regions, interference methods connected with wedge cells are usually applied. In these cases interference fringes in wedge cells in VIS and NIR regions are recorded by CCD camera without NIR filter. In this method (with $\delta n<0.005$) there is no limit as for magnitude of $n_e(\lambda)$.

The main task of this work is a suggestion to propose an efficient, direct and accurate (with $\delta n<0.02$) interference method in special planar cells for determination of $n_e(\lambda)$ and $n_o(\lambda)$ in Vis, NIR, SWIR and MWIR ranges for NLCs including High Birefringence Liquid Crystal Mixtures (HBLCM) with n_e smaller than 2.1 for $\lambda\in[0.4\ \mu m, 4.2\ \mu m]$.