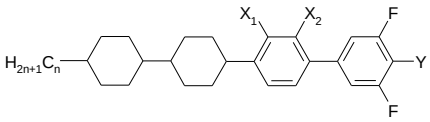
Liquid crystalline mixtures with low and medium birefringence for dual frequency addressing

R. Dąbrowski,[1] O. Chojnowska,[1*] K. Garbat,[1] S. Urban,[2] M. Celiński,[1] R. Mazur,[3] W. Piecek[3]

1 Institute of Chemistry, Military University of Technology, Warsaw, Poland
2 Institute of Physics, Jagiellonian University, Krakow, Poland
3 Institute of Applied Physics, Military University of Technology, Warsaw, Poland

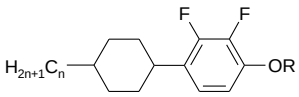
Dual frequency (DF) addressing technique is a very effective tool for shortening and symmetrisation of the response times (τ_{on}, τ_{off}), since they are both voltage dependent. For this purpose liquid crystal materials (LCMs) are needed, wherein dielectric anisotropy $\Delta\varepsilon=\varepsilon_{\parallel}-\varepsilon_{\perp}$ changes its sign from a positive to a negative value, while the frequency of an electric field increases. Already known materials were designed using multiring cyanoesters[1] as a component responsible for $\Delta\varepsilon>0$ at low frequency range, what exclude them to be controlled by an active matrix, because of a low holding ratio. Recently we have found that bicyclohexylbiphenyl derivatives of the formula 1[2] exhibit flip-flop rotation around short axis at low frequency (f_r in the range 2-10 kHz at 20°C). They have simultaneously low melting temperatures, enthalpies and high chemical stability as well as high resistivity, therefore they can be useful for DF mixtures formulation.



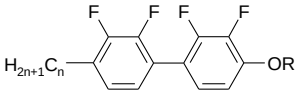
(1)

wherein X_1 and X_2=F or H and Y=F, OCF_3, NCS

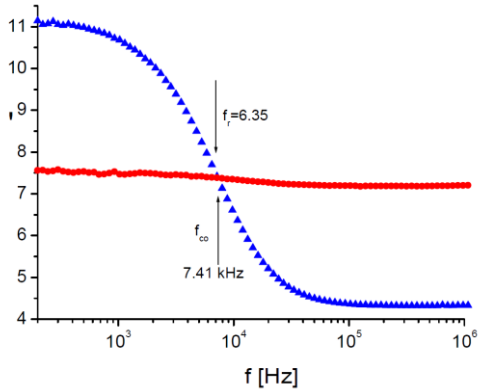
Convenient dielectrically negative low or medium birefringent liquid crystals such as compound 2 or 3 have been found.



(2) and



(3)



DF frequency mixture with Δn=0.1-0.3 and f_{co}=3-10 kHz at 20°C have been created. They have similar response times $\tau_{on}\sim\tau_{off}$ and the total $\tau_{on}+\tau_{off}$ < 1ms for applied voltage below 20 V. Examples of prepared LCMs for DF addressing will be presented in details.

Acknowledgement: This work was supported by the project of the Polish Ministry of Science and Higher Education PBS 847 and by the project POIG.01.03.01-14-016/08 "New photonic materials and their advanced application".

References:

[1] H. Xianyu, S.-T. Wu, C.-L. Lin, *Dual frequency liquid crystals: a review*, Liquid Crystals, **36** (6-7), 717–726 (2009).

[2] R. Dąbrowski, M. Celiński, O. Chojnowska, P. Kula, J. Dziaduszek, S. Urban, *Compounds with low relaxation frequency and dual frequency mixtures useful for active matrix addressing*, Liquid Crystals, **40** (10), 1339-1353 (2013).

* presenting author; E-mail: ochojnowska@wat.edu.pl