Multistability and domain structures in smectic materials

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We investigated the effect of multistability in smectic materials, i.e. a possibility of equiprobable existence of a large (almost infinite) number of states in the same material under the same conditions. The multistable smectic materials were discovered recently, and even a display prototype was already built up [1]. However, the origin of this phenomenon was not understood clearly up to now. A multistable material can easily be switched from one state to another one by application of the small electric field, and it remains in the last state without energy consumption until the electric field is applied again. Another important feature is that the number of equiprobable states is very large, so that the optical properties of the material can vary smoothly on application of the appropriate value of the electric field. The switching times are typical for smectics, i.e. much faster than in nematics and cholesterics.

During our investigations we formulated the two requirements for the smectic material to be multistable: (1) it must be non-helical; (2) at the same time, azimuthal rotation of the director from layer to layer without direction preference must exist. In this case the two equiprobable rotation directions will exist in every smectic layer [2], and generally there will be 2^N equiprobable states in the whole sample, where N is the total number of smectic layers.

In the presence of electric field, the smectic material of this kind will form the non-helical domains (**Fig. 1**). An analytical solution for the director azimuthal distribution along the smectic layer normal is presented in **Fig. 2**. It shows the oscillations, whose amplitude and frequency depend on the applied electric field.

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[1] E.P. Pozhidaev, V.G. Chigrinov, Yu.P. Bobilev, et.al, *J. of SID*, **2006,** *14*, 633.
[2] A.V. Emelyanenko, A. Fukuda, and J.K. Vij, *Phys. Rev. E,* **2006,** *74,* 011705.

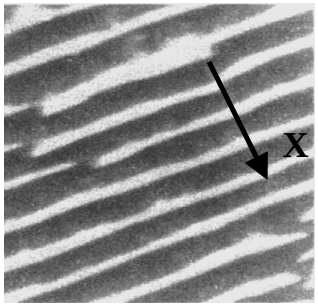

Fig. 1

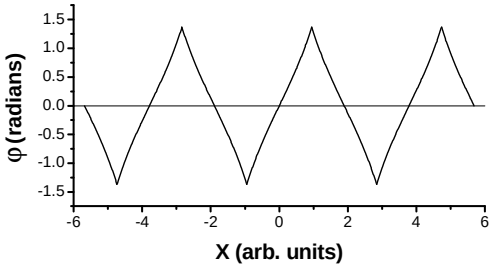

Fig.2