Switching between nematic filled states: flexoelectric and order-electric couplings

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Using numerical simulations, we model a nematic liquid crystal, in coexistence with its isotropic phase, filling a substrate patterned with rectangular grooves. We analyse its response to an externally-applied electric field, under flexoelectric and order-electric coupling, with an emphasis on identifying switching transitions between bistable morphological states. We identify that order-electricity provides a means of switching between states where the plateaux between grooves are dry and where they are wet by a nematic layer, without affecting the configuration of the nematic within the groove. We identify that flexoelectricity is a viable means of changing the topological configuration of the nematic in the groove, provided that the coupling differentiates between the type of distortion at the corners of the substrate. We determine precisely the field magnitudes and orientations required to effect each type of transition.