Telephone-cord instabilities in thin smectic capillaries

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Abstract.   Telephone-cord patterns have been recently observed in smectic liquid crystal capillaries. In this paper we analyse the effects that may induce them. As long as the capillary keeps its linear shape, we show that a nonzero chiral cholesteric pitch favors the SmA*-SmC* transition. However, neither the cholesteric pitch nor the presence of an intrinsic bending stress are able to give rise to a curved capillary shape.

The key ingredient for the telephone-cord instability is spontaneous polarization. The free energy minimizer of a spontaneously polarized SmA* is attained on a planar capillary, characterized by a nonzero curvature. More interestingly, in the SmC* phase the combined effect of the molecular tilt and the spontaneous polarization pushes towards a helicoidal capillary shape, with nonzero curvature and torsion.