Thermomigration and Thermal Convection in Freely-Suspended Smectic Liquid Crystal Films and Bubbles in Microgravity

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Temperature-gradient-induced[1] CHEOL PARK, MATT GLASER, JOE MACLENNAN, NOEL CLARK, Physics Department and Soft Materials Research Center, University of Colorado, TORSTEN TRITTEL, RALF STANNARIUS, Otto von Guericke University, Magdeburg, Germany — Freely-suspended smectic films of sub-micrometer thickness and lateral extensions of several millimeters were used to study thermally driven migration and convection in the film plane. Film experiments were performed during the 6 minute microgravity phase of a TEXUS suborbital rocket flight (Texus 52, launched April 27, 2015). We have found an attraction of the smectic material towards the cold edge of the film in a temperature gradient, similar to the Soret effect. This process is reversed when this edge is heated up again. Thermal convection driven by two thermocontacts in the film is practically absent, even at temperature gradients up to 10 K/mm, with thermally driven convection only setting in when the hot post reaches the transition temperature to the nematic phase. The Observation and Analysis of Smectic Islands in Space (OASIS) flight hardware was launched on SpaceX-6 in April 2015 and experiments on smectic bubbles were carried out on the International Space Station using four different smectic A and C liquid crystal materials in separate sample chambers. We observed that smectic islands on the surface of the bubbles migrated towards the colder part of the bubble in a temperature gradient.

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