Developing a Design Strategy for ‘de Vries-like’ Liquid Crystals: Tuning the Frustration Between SmA- and SmC-Promoting Elements

PhD candidate: Qingxiang Song

Smectic liquid crystals with ‘de Vries-like’ properties are characterized by a maximum layer contraction of <1% upon transition from the non-tilted SmA phase to the tilted SmC phase. In previous studies, we developed a rational design strategy based on a concept of frustration between two structural elements on a 2-phenylpyrimidine mesogenic scaffold, one promoting the formation of a SmA phase (chloro-terminated chain) and another promoting the formation of a SmC phase (siloxane-terminated chain). In this thesis, we show that one can tune the frustration—and further improve de Vries-like properties—by substituting the 2-phenylpyrimidine core in our first-generation siloxane-terminated mesogens with one of three cores known to be stronger SmC-promoting elements: 6-phenylpyridazine, 2-phenylpyridine and 2-phenylthiadiazole. We also address a fundamental design flaw of siloxane-terminated mesogens, i.e., the hydrolytic instability of siloxane oligomers, by substituting the siloxane end-group with a chemically inert carbosilane end-group. As a result of this study, we found a carbosilane-terminated 2-phenylthiadiazole mesogen that forms a SmC phase at room temperature with de Vries-like properties that are comparable to those of bona fide de Vries-like liquid crystals.