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2018 IRG1 Intellectual Merit

IRG1: Organic Glasses with Tunable Liquid-Crystalline Order

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Glasses are usually isotropic, with the molecules oriented in all directions, but anisotropic glasses with a preferred molecular orientation are better for applications such as organic electronics. Liquid crystals (LCs) can have strong preferred orientation, but it has not been possible previously to take full advantage of that order in solid, glassy materials.

IRG 1 researchers of the Wisconsin MRSEC have shown that by cooling at different rates, a LC can be transformed into a glass in which molecular packing can be systematically altered. Cooling the LCFforming molecule itraconazole at different rates can fully or partially arrest its phase transitions, producing glasses with adjustable molecular layering and orientational order. The cooling rates are controlled by the different time scales for endF overFend and longFaxis molecular rotation, suggesting a general condition for organic glasses with tunable LC order.

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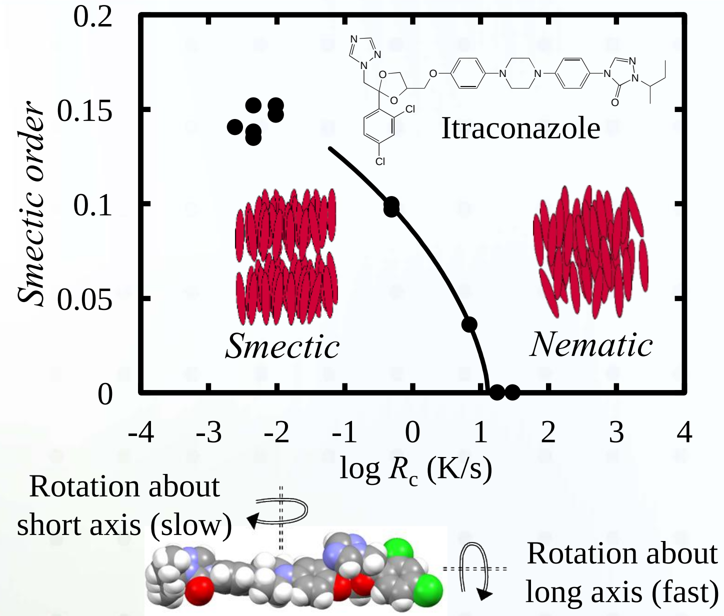

Smectic order of glasses prepared by cooling a LC at different rates (R_c). At R_c > 20 K/s, molecular layering (smectic order) is avoided, producing glasses with only orientational (nematic order). At slower R_c, glasses contain varying degrees of smectic order determined by the temperature at which the end-over-end molecular rotation is frozen.

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