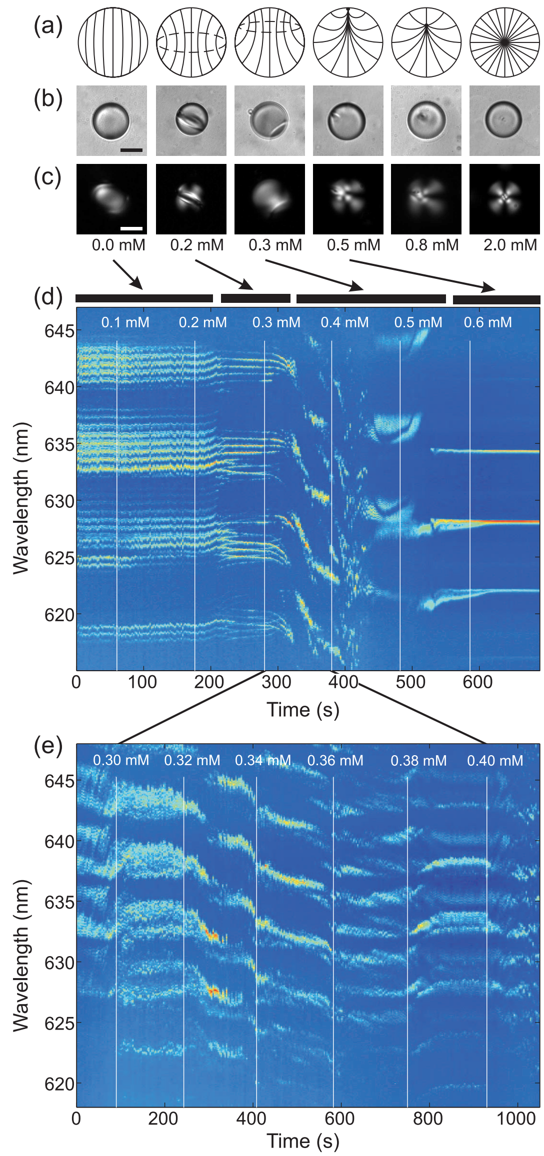

Fig. 4. Changes of the structure of a small droplet of the nematic liquid crystal at increasing concentrations of SDS. (a) The lines represent the orientation of the long axes of the LC molecules. The dots are point defects, where the orientation is not defined. In pure water, the LC molecules align parallel to the water-LC interface and the structure is bipolar. By increasing the SDS concentration, the surface anchoring of LC molecules gradually changes towards the perpendicular molecular orientation, obtained at 2.0 mM of SDS and beyond. (b) Non-polarized optical microscope images of $\sim 17\,\mu$m diameter microdroplets of 5CB in water and SDS. The "inner" ring is observable at 0.2 mM of SDS. The point defect evolves at the surface and sinks into the center at 0.8 mM concentration of SDS. Scale bar $10\,\mu$m. (c) The same images as in (b), taken between crossed polarizers. (d) The spectrum of laser light, emitted from a $13\,\mu$m 5CB droplet in water with various concentrations of SDS added. (e) Part of the lasing spectrum in the "chaotic" regime of intermediate SDS concentrations ($0.3-0.4$ mM) of a $16\,\mu$m droplet.

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5. Conclusion

Our results demonstrate that lasing from LC microdroplets provides for a versatile and simple method of monitoring the internal orientational structure of LC microdroplets. Because the orientation of LC inside the droplet critically depends on the anchoring of the LC at the surface of microdroplets, the lasing spectra provides direct information on the molecular adsorption/desorption processes at the surface of microdroplets. The developed sensing method could be easily integrated into existing microfluidics chips. Monodispersed LC droplets could be formed within a microchannel [22] and the excitation and detection of fluorescent light could be achieved through the integrated optical fibers [23]. Monitoring and automated recognition of the lasing spectra from LC microdroplets has therefore a clear advantage in comparison to the conventional observation of individual droplets under an optical microscope and could provide efficient and automated readout of the presence of targeted molecules in water, surrounding the LC microdroplet sensor.

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