

# Water-responsive dual-coloured photonic polymer coatings based on cholesteric liquid crystals

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## Experimental

### Materials

Unless stated otherwise, all reagents and chemicals were obtained from commercial sources. Chiral dopant **1** was purchased from BASF. Compound **2** was obtained from Merck and monomer **3** was custom-made by Synthon. Benzoic acid derivatives **4** and **5** were prepared by Philips and Synthon respectively. Photoinitiator **6** and inhibitor **7** were obtained from CIBA and Fluka respectively. All solvents were obtained from Biosolve. The silanes for substrate modification were obtained from Sigma-Aldrich.

### Characterisation of materials

For UV/Vis spectroscopy of the films, an HR2000+ high-resolution spectrometer from Ocean Optics mounted on a DM6000 M microscope from Leica microsystems was used. The corresponding light source emits between 400 and 800 nm. A Varian 670 FT-IR spectrometer with slide-on ATR (Ge) and a Varian-3100 FT-IR spectrometer were used to measure IR spectra. Height profiles and 3D images of patterned films were recorded using a 3D interferometer (Fogale Nanotech Zoomsurf). Photographs were taken with a Canon EOS 60D camera mounted on a Leica MZ6 stereoscope. The UV light intensities produced by the collimated EXFO Omnicure S2000 lamp were determined using a UV Power Puck II by EIT Instrument Markets Group. Spin coating was performed on a Karl Suss RC6 spin coater.

### Glass functionalisation

Glass substrates were cleaned by sonication (ethanol, 15 minutes), followed by treatment in a UV-ozone photoreactor (Ultra Violet Products, PR-100, 20 minutes). The surface of the glass substrates was modified by spin coating 3-(trimethoxysilyl)propyl methacrylate solution (1 vol% solution in a 1:1 water-isopropanol mixture) or 1*H*,1*H*,2*H*,2*H*-perfluorodecyltriethoxysilane solution (1 vol% solution in ethanol) onto the activated glass substrate for 45 seconds at 3000 rpm. The substrates were ready to use after curing for 10 minutes at 100 °C.

### Preparation of a the CLC mixture

A typical green-reflecting CLC-mixture was prepared by dissolving compounds **1-7**, respectively 4.5, 13.0, 38.0, 21.9, 21.9, 0.1 and 0.6 wt%, in four weight equivalents of THF. In the case of the mixtures with a different amount of chiral dopant, the amount of compound **1** was increased or decreased, while the ratio between the other compounds was kept constant.

### Preparation of water-responsive coatings

Water-responsive topographies with a typical thickness of between 8 and 10 µm were prepared as follows: 20 µl of the CLC mixture was placed on a methacrylate functionalised glass substrate at 70 °C and the solvent was allowed to evaporate. After complete evaporation of THF, a perfluorodecyl-triethoxysilane functionalised glass substrate was placed on top and pressed firmly. At lower temperatures (between 50 °C and room temperature, where the mixture is in the liquid crystalline state), the chiral nematic liquid crystals were aligned by shear forces. The contents of the cells of the homogenous films were photopolymerised at room temperature for 300 seconds (48 mW/cm<sup>2</sup> intensity in the range 320-390 nm). In case of the patterned coatings, the cells were placed on a black surface. A mask was placed on top of the sample and the sample was exposed to UV light (0.2 sec, 48 mW/cm<sup>2</sup> intensity in the range 320-390 nm) at a set temperature. Afterwards, the mask was removed, the cell was equilibrated at the second set temperature and the mixture was exposed for an additional 300 seconds (48 mW/cm<sup>2</sup> intensity in the range 320-390 nm) to ensure complete polymerisation. The upper perfluorodecyl functionalised glass substrates could be easily removed with a razor blade.

### Formation of the hydroscopic polymer salt coatings

Coatings were activated by placing them in 0.1 M KOH-solution for 10 hours to ensure complete deprotonation of the hydrogen-bonded benzoic acid derivatives. The samples were used after drying at room temperature (RH = 40%, T = 20 °C).