nature materials

ARTICLES

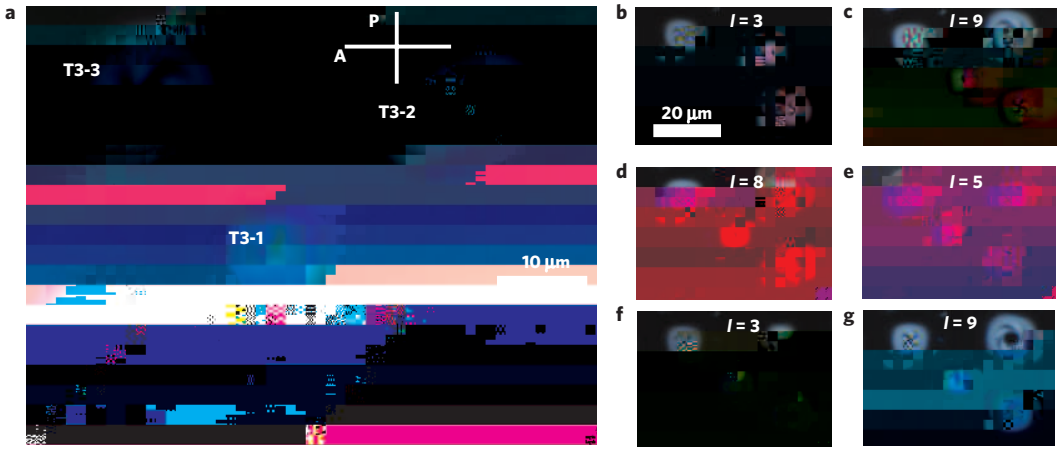

Figure 2 | Predetermined optical generation and switching of the toron structures. a, Polarizing optical microscopy texture showing T3-1 (the smallest), two T3-2s of opposite winding (intermediate size) and T3-3 (the largest structure) generated next to each other. The inset shows the letters 'CU' obtained by optical generation of four T3-2s per letter at the letters' vertices and T3-1 elsewhere within the characters. The orientations of the crossed polarizer (P) and analyser (A) are shown by the white bars. **b**

Table 1 | Material parameters of the used nematic hosts and chiral additives.

Material/property	K_{11} (pN)	K_{22} (pN)	K_{33} (pN)	$\Delta\varepsilon_{lf}$	Δn	H_{HTP} of CB-15 (μm^{-1})	H_{HTP} of S-811 (μm^{-1})
MLC-6609	17.2	7.51	17.9	−3.7	0.078	-	−10.5
ZLI-3412	14.1	6.7	15.5	+3.4	0.078	+6.3	−8.8
MLC-6815	-	-	-	+8.1	0.052	+6.5	−10.7

example, the letters 'CU' in the inset of Fig. 2a are composed of T3-2s at the corners and T3-1s elsewhere within the characters. Generation of different T3s depends on the initial laser-induced director tilt from the vertical alignment, which, in turn, depends on the intensity distributions shown in Fig. 1g–j. Beams having large $|l|$ with high-intensity lobes in the axial plane pointing outward from the low-intensity centre generate T3-2s or T3-3s, whereas the beams with small $|l|$ generate T3-1s. For example, in a cell with $p \approx d = 5\,\mu m$, the T3-1 structure is induced by the Laguerre–Gaussian beams of $l = \pm(0 - 4)$, the T3-2 is observed for $l = \pm(4 - 8)$ and T3-3 is observed for $|l| > 8$. Therefore, T3s can be reversibly transformed between each other as shown in the top right corner of Fig. 2c–g. The threshold generating laser powers are comparable for all T3s and vary from 60 mW for $l =$


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SUPPLEMENTARY INFORMATION

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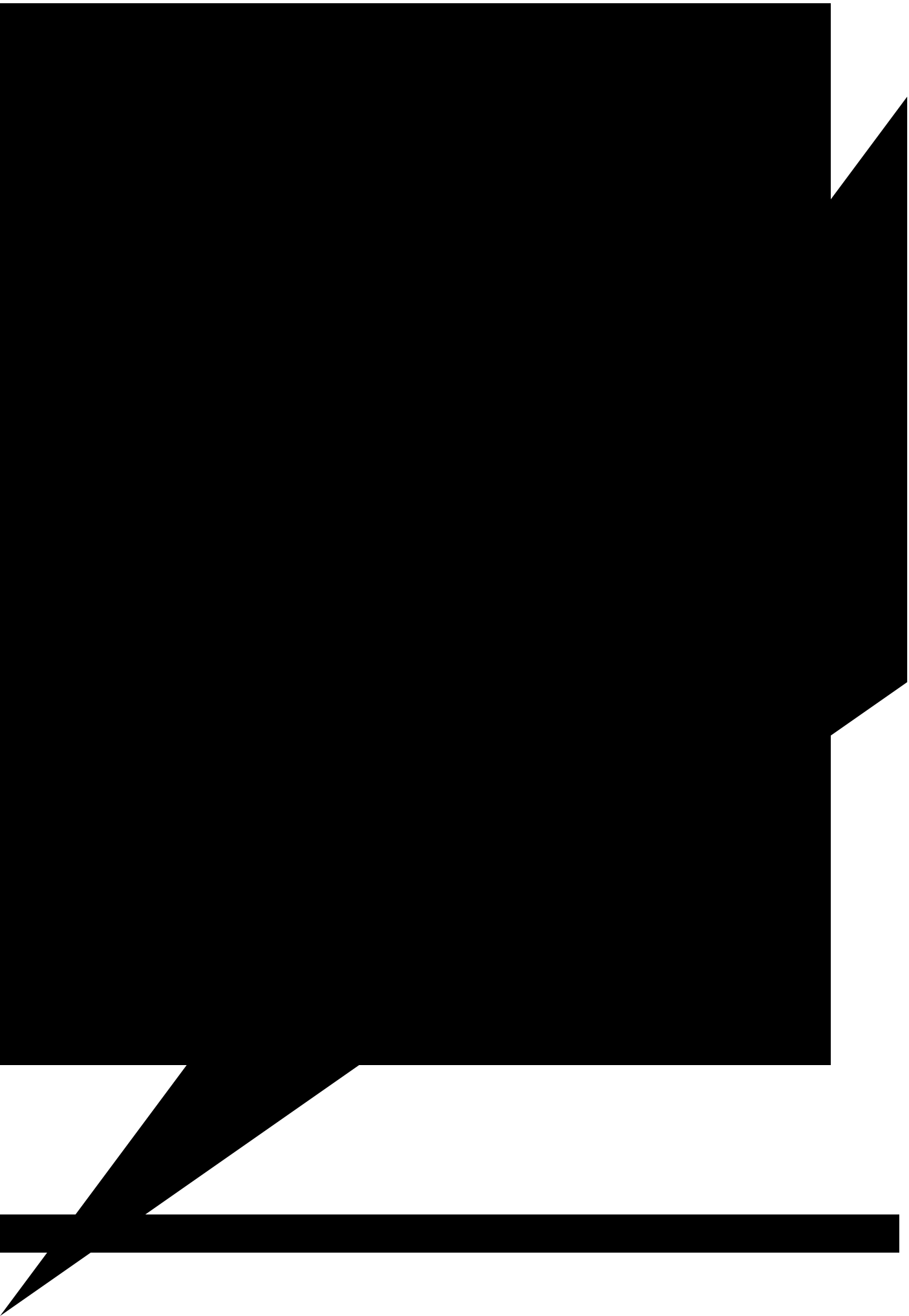

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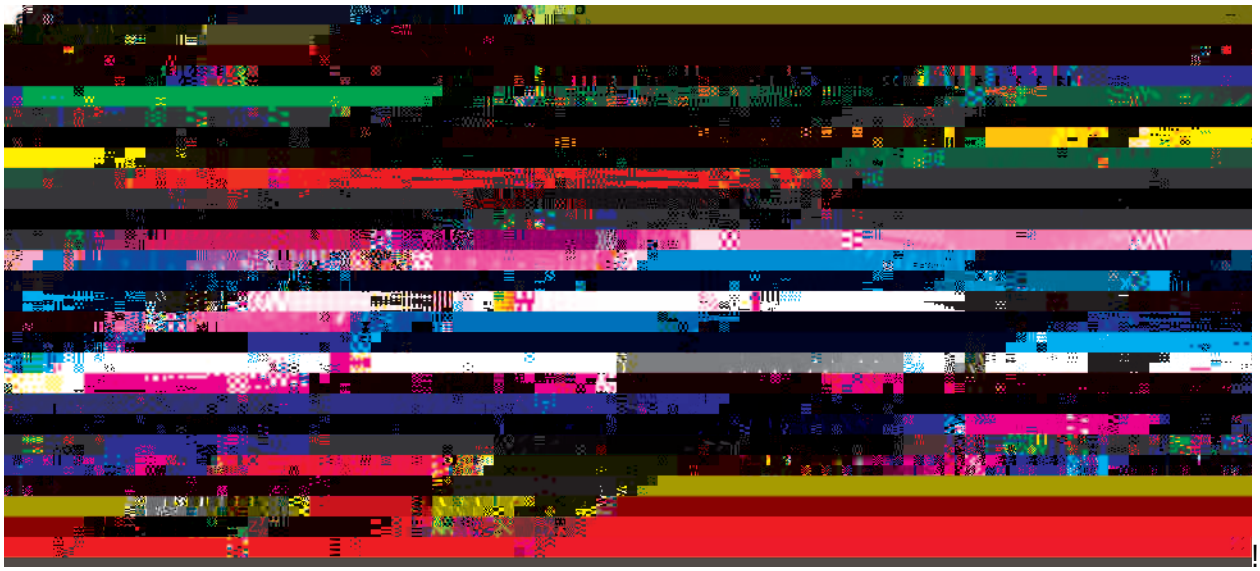

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0&4=12,!N/,I ; J ?=:21M<& J =@6:27,Q21:896@,91 ; <<M<29:& ; 3<, ; K,:L2,(NM . ,<:1=9:=12/,,6G!<5$!&/)%+/%)$!+0 ' &*&/&!01!/5$!) , 7*,-!/B*&/!01! $\hat{n}(\vec{r})$ *' !/5$!+$ ' /) ,-!=-, ' $!01!/5$!+$--! ,&!B$--! ,&!/B0!=0*' /!7$1$+/&!+-0&$!/0!/5$!&%4&/) ,/$&j!/5$!*' &$/&!&50B!&* (%-,/$7! ^(ᵕ)