**Liquid-crystal periodic zigzags from geometrical and surface-anchoring-induced confinement: Origin and internal structure from mesoscopic scale to molecular level**

<span id="page-0-2"></span><span id="page-0-1"></span><span id="page-0-0"></span>

 $10 \text{m/s}$ , and  $t_{\text{m}}$  from  $\frac{m}{3}$  to  $100 \mu^2$ , regular regula  $\frac{1}{2}$  silicar microspheres  $\frac{1}{2}$  microspheres for controlling for con  $\mathfrak s$  t.  $\mathfrak s$  the patterned silicon. To control the silicon. To control the silicon. The simulation of the silicon. The sim  $s$ ,  $r_{\rm max}$  and  $r_{\rm max}$ , the glass and path  $r_{\rm max}$  and  $r_{\rm max}$ chemically cleaned by immersion in a mixture of dimethylformation and  $\mathbf{r}$  is the method organic investigation or  $\mathbf{r}$ rt, frinsing several times with definition  $\mathfrak{e}$  is the several times with definition  $\mathfrak{e}$  $T = t$ , two surfaces, patterned silicon and glass, were spinning since  $s$ coated with a fluoring  $\mathbf{r}$  and  $\mathbf{r}$  and  $\mathbf{r}$  and  $\mathbf{r}$  are Teflon-AFs, Dupont in  $\mathbf{r} = \mathbf{r} + \mathbf{r} + \mathbf{t}$  solvent Fluorinert TM FC-77, 3 M<sub>an</sub>t obtain planer and  $\mathbf{r}$  $\begin{array}{ccc} \text{R} & \text{M} & \text{L} \\ \text{R} & \text{R} & \text{R} & \text{S} \\ \text{R} & \text{R} & \text{S} & \text{R} \end{array}$  . During the sample loading the sample loading to the sample locality of the sample locality of the sample locality of the sample locality of glass-tt r silicon hybrid cell equipped with a hot stage  $r_{\rm max}$  to the test  $\epsilon$  $M$ ttr $F$ P82 H $T$  st<sub>on</sub>t thrtp  $\sin \theta$  t - s transition temperature 194.7 °C to facility temperature 194.7 °C to facility 194.7 °C ttt<sub>ate</sub> flor 1 tt<sub>t</sub>, the cooled down at  $-2$  C/

 $\frac{C}{\sqrt{C}}$  **m**  $\frac{M}{\sqrt{C}}$  s<sub>r</sub>  $\frac{M}{\sqrt{C}}$  ts  $\frac{C}{\sqrt{C}}$  or  $\frac{C}{\sqrt{C}}$  out t<sub>he</sub>  $\int f(t) \cdot \Pr \left[ -8 \cdot F \ldots \right] \frac{5}{M} \quad t \quad \frac{8}{M} \quad \left[ 1 \text{ tr} \right]$ tr $H$ , A fr $s$  and  $\int_{\mathbb{R}} 1 \mu s$  target of  $11_{\rm AA}$   $\downarrow$   $\downarrow$   $\downarrow$   $\uparrow$   $\uparrow$   $\downarrow$   $\downarrow$   $\uparrow$   $\uparrow$   $\uparrow$   $\downarrow$   $\downarrow$   $\downarrow$   $\uparrow$   $\downarrow$   $\downarrow$   $\downarrow$ helium chamber et 100 nm resolved **xyz** highprecise linear motor stages. The sine states is sampled to the samples of  $\mathfrak{g}$  is  $\mathfrak{g}$  in the same states of  $\mathfrak{g}$ t<sub>an</sub>  $\frac{165 \mid \cdot \cdot \cdot}{}$  true tf r 60 s t t-dimensional 2D charge-coupled detectors that  $t$  $r = t$ ,  $\sqrt[n]{r} t$ , NJ .

*Polarized optical and electron microscopy*: The optical

<span id="page-1-0"></span>anstrict ters risor ring the served under polarized observed under polarized optical variable  $\alpha$  $\Gamma$  s L DMLB. For scanning triangless entitled microscopy electron microscopy el EMs, LC  $\frac{1}{2}$ s rfr $t$ r  $\frac{1}{2}$  in the li trogen, to t 5 in fPt, i.e.,  $\mathfrak{s}$  . FEI  $\Gamma$  FE-EM tNt N f C triNNFC Kr A Ist $t$ t f  $\mathfrak{C}$  . KAI $\mathfrak{C}$  .

## **III. RESULTS**

 $\mathfrak{N}$  r -s rst l,  $4'$ -5,5,6,6,7,7,8,8,9,9,10,10,11,11,12,12,12-heptadecafluoro- $r -$ -  $-4-\frac{c}{2a}$  t str, ssts rittlt r<sub>o</sub>n method [1](#page-1-0) F.s.  $1_{AB}$  2 t s<sub>v</sub> it the tr  $4,16,17$  $4,16,17$  $4,16,17$ ,  $\mathbb T$  the stratsitud fraction of liquid crystal 1 exhibits a transition upon the intervals of  $\int_{\mathbb{R}} f(x,y) \, dx = \int_{\mathbb{R}} f(x,y) \, dx$  $s$  t-  $s_{\text{av}} = 185$  C, then the s<sub>m</sub>ectic a sft r st  $\overline{t}$  s t =111 C. The small  $str_{AB}t$  r f  $l$   $_{MAB}r$  st 1 s  $st_{AB}$  D 1-mmdiameter and  $\frac{1}{2}$  and  $\frac{1}{2}$  the set of  $\frac{1}{2}$  set of  $\frac{1}{2}$  set of  $\frac{1}{2}$  second by  $\frac{1}{2}$ polyimide film in copper cells for copper cells  $\mathbf{r}$  and  $\mathbf{r}$  and  $\mathbf{r}$  and  $\mathbf{r}$  and  $\mathbf{r}$  and  $\mathbf{r}$  $f$  single single representation. In particular,  $\mathbf{r}$  is also carried out on  $\mathbf{r}$  $\mathbf{r}$  the channel cell described below.  $\Gamma$  single domain manns in the single domain  $\Gamma$  shown several manns in  $\Gamma$ er s  $r_{\text{av}}$  s t s in the small angle between  $t = 1.0$  and  $t = 1.1$  $\begin{array}{ccc} r & s & r_{\text{AM}} & s & t & s \\ r & =6.0 & \begin{array}{ccc} 1 & 0 & -s \\ 0 & 1 & 0 \end{array} & \text{at} & t & s & r & s \end{array}$ case of bilayered fluid smectic phase in polar compounds  $\text{str}$  t<sub>w</sub> fr r r r . [18,](#page-5-3)[19](#page-5-4). The polar semification set liquid tas for  $r$  st liquid crystal 1 cause species in  $\mathbb{R}$  in  $\mathbb{R}$  in  $\mathbb{R}$  in  $\mathbb{R}$  , which depends in  $\mathbb{R}$  is  $\mathbb{R}$  in  $\mathbb{R}$  in  $\mathbb{R}$  in  $\mathbb{R}$  is  $\mathbb{R}$  in  $\mathbb{R}$  in  $\mathbb{R}$  is  $\mathbb{R}$  in  $\mathbb{R}$  is  $\mathbb{R}$  in  $\mathbb{R}$ on dipole delocalization  $t = 19.$  $t = 19.$  $t = 19.$  B s t s  $t = t$ , t  $t = t$  $\mathbf{s}$  is a set of the meridion on the meridion  $\mathbf{s}$  is a set of meridional line, , , , , , , if is set of are split from the meridion of a modulated meridion of a modulated value o  $\Gamma$  structure. The peak positions accurately match with the peak positions accurately match with the peak positions accurately match with the peak positions are match with the peak positions and the peak positions are ma body-centered rectangular structure in unit centered rectangular structure in  $\mathbf{f}$  $=6.02$  nm  $=7.20$  nm  $A$  three diffuses **p**  $\mathbf{p}_{\text{off}}$  **i** t<sub>he wi</sub>de angles in 1=12.6 nm<sup>-1</sup>, 2=15.3  $\begin{bmatrix} 1, & 3 \\ 3, & 3 \end{bmatrix}$  3=17.0  $\begin{bmatrix} 1, & t \\ 3, & 1 \end{bmatrix}$  is set if set if  $\begin{bmatrix} 1, & 3 \\ 3, & 1 \end{bmatrix}$  $f(r \thinspace t \thinspace t \thinspace t \thinspace t \thinspace t \thinspace t \thinspace s \thinspace m \thinspace r \thinspace r \thinspace s \thinspace m \thinspace r \thinspace s \thinspace m \thinspace r \thinspace r \thinspace r \thinspace s \thinspace m$ level structure of  $\mathfrak{g}_{\mathcal{M}}$  , structure  $\mathfrak{g}_{\mathcal{M}}$  is the  $\mathfrak{g}_{\mathcal{M}}$  and  $\mathfrak{g}_{\mathcal{M}}$ ests frits tthe molecular simulations of  $\mathfrak{g}$  $s$  ft r . CEI<sub>L</sub> 2 A r s, D . CA, A. As F. [3](#page-3-0), list 1 sstatus turn  $\pi$ <br>status traction between and  $\pi$ the space for rest let s  $\sim$  3.52 nm. Fritt 1 peak the mean distance between the mean distance between the semi-fluoroal chains of  $\mathfrak{g}$  $f \sim 0.50$   $\mu$  2 sr t tt the ft r  $\frac{1}{5}$ , ~0.41 i. 3 it  $\frac{1}{5}$  /F3 3-400.8 it  $\frac{1}{5}$ /F3 64214F3 642 <span id="page-2-0"></span> $\Gamma$  t surfaces, the spin silicon and glass, respi t t rit  $r \in \mathbb{R}$ ,  $R \in \mathbb{R}$ , Dupont  $r = \sqrt{r}$   $r = t$   $s = t \cdot F$ ,  $r = r \cdot m$  FC-77, 3 M  $m$ obtain planer and planer and  $\mathfrak{p}$  is semi-fluoring of the LC  $\mathfrak{p}_M$ largers not t<sub>an</sub> surface . During t<sub>he sample is</sub> the sample to the sample of  $t_{\text{max}}$  $\mathfrak{s}$  to a temperature to a temperature above the smectic transmetries to a temperature above the small te  $st$  the right the capital temperature to facilitate the capital  $c$ tts tttft the s<sub>att</sub> r<sub>an</sub>s the ss F<sub>ig.</sub> [1](#page-1-0) , followed by cooling to room. the resulting resulting  $\mathfrak{g}_{\mathbf{M}}$  fLC resulting  $\mathfrak{g}_{\mathbf{M}}$  fLC resulting by glass on the top, silicon on the bottom, and air on the two  $s$   $s$  fLC  $s$  ring  $s$  is planet and  $s$  $\frac{1}{20}$  tt sinfults sstris,  $\mathbf{tr}$  rs  $\mathbf{r}$  tt surface 5.3814 0 TDT

<span id="page-3-0"></span>

buth  $\mathbb{R}$  X<sub>a</sub>nternet patterns obtained at A1–A3 exhibit the structure structure, differing on  $t$  is the structure, differing only in the  $t$ t<sub>at</sub> At A2, st r r ft<sub>at</sub>, t  $00 \text{ s}$  small and  $0 \text{ s}$  small and up along  $0 \text{ s}$  $str$  rt. At A1 A3 there ret  $\theta_{\text{AM}}$  are  $\theta_{\text{AM}}$  $\mathbf{s}$  is  $\mathbf{s}$ <sub>an</sub>t to that A2, confirming that  $\mathbf{r}$ undulastic accompanies the optical  $\mathfrak{g}_t$ distribution orientation orientation  $\mathfrak{g}$  the scattering the scattering the scattering the scattering the scattering terms of  $\mathfrak{g}$ tring Fig. [3](#page-3-0) , i.<u>e., t<sub>ou</sub> t<sub>ou</sub> the a-c<sub>e pla</sub> tt</u> gass.  $\mathfrak{N}$  single  $\mathfrak{g}$  sample  $\mathfrak{g}$  sample  $\mathfrak{g}$  sample  $\mathfrak{g}$  $\Box$ , tritt,  $\mathrm{rt} \Box$ , tuttice may be origination. entationally distinct about  $\mathfrak{g}_{\mathfrak{m}}$  in the  $\mathfrak{g}_{\mathfrak{m}}$ 

The mechanism leading to unduction formation for the mechanism of the  $\mathfrak s$ , ntr $\mathfrak s$  , t $\mathfrak s$  threshold, to smoothly undulated layers. H<sub>ow</sub>n, the structure as  $\lim_{M \to \infty} t$  structure as  $\lim_{M \to \infty} t$  in the cells as  $\lim_{M \to \infty} t$  $\mathfrak{z}$ titt $\mathfrak{z}$  ternation between layer segments running parallel tt in the ,  $\frac{1}{2}$  plane in the  $\frac{1}{2}$ in Fig. [1](#page-1-0) and  $2$  , Fig. 3 4 ft supplement states  $\frac{1}{2}$  $\text{tr} \quad \text{tr} \quad 17, \quad \text{as} \quad \text{tstr} \quad \text{t.}$  $\text{tr} \quad \text{tr} \quad 17, \quad \text{as} \quad \text{tstr} \quad \text{t.}$  $\text{tr} \quad \text{tr} \quad 17, \quad \text{as} \quad \text{tstr} \quad \text{t.}$  $s \t n$  r. t<sub>hat</sub>  $s \t_{m}$  s,  $s \t s_{m}$  f tr  $\text{str}$  is that is more complex than simple undulations. Mr systematic experiment  $\mathfrak{g}$  is the their relationship will be a set of  $\mathfrak{g}$  $s \mapsto s$  differ to  $f_{\text{tot}}$  of the evolution of  $t = t_{\text{tot}} t$ ttrs stes ritss stest und  $\mathfrak{g}$  range of the confidence of  $\mathfrak{g}$ and with increasing different control of  $\mathfrak{t}$  is, in particular periodic particular periodic parabolic for parabolic superiodic superiodic superiodic for  $\mathfrak{g}$  PFCs, or st<sub>rus</sub> PFCs  $8,10,14,15$  $8,10,14,15$  $8,10,14,15$  $8,10,14,15$ . The set array internal intern core of multiply connected curved layers that have nearly the  $r$ -stress rspacing everywhere, thereby reducing the spacing thereby reducing the spacing thereby reducing the spacing theorem is the spacing theorem in the spacing theorem is the spacing theorem in the spacing theorem is

 $\begin{tabular}{l|cccccc|cccccc|cccccc|} \hline $\mathfrak{P}$ & $t\neq r$ & $r$ & $r$ & $s$ & $t$ & $\mathfrak{s}$ \\ \hline $F,\, \mathfrak{s},\, 2\quad ,\, 4\quad ,\quad & 4\quad & $\mathfrak{m}$ & $r\,\mathfrak{s}\, r$ & $\mathfrak{s}\, t$ & $\mathfrak{s}$ & $t$ \\ \hline $\mathfrak{M}^t$ & $\mathfrak{M}^t$ & $f$ & $\mathfrak{m}$ & $\mathfrak{s}$ & $t$ & $\mathfrak{s}\, t$ & $r$ & $r$ \\ \hline $t$ & $t$ & $t$ & $t$ 

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