Supplementary Information

Three-dimensional imaging of liquid crystal structures and defects by means of holographic manipulation of colloidal nanowires with faceted sidewalls

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Supplementary Methods

Nanorod preparation. The GaN nanorods are grown by molecular beam epitaxy under conditions of high substrate temperature (810-830 ºC) and high nitrogen plasma flux at a chamber pressure of ~2.6 mPa. The nanorods nucleate spontaneously under these growth conditions on thin AlN buffer layers on Si(111) substrates. The nanorod growth rates were 0.1-0.2 μm/h and typical growth lengths were from 12 μm to 15 μm (varying from one part of the wafer to another). The dispersed nanorods used in this work typically break off with lengths of ~10 μm. Further details of the growth mechanism and conditions for the GaN nanorods have been reported elsewhere.[1,2] The nanorods were doped with Si during growth such that a free carrier concentration between 3×10^{17} cm^{-3} and 1×10^{18} cm^{-3} was obtained. At these doping levels, the absorption coefficient is ~80 cm^{-1} at 1064 nm.[3] The long axis of the nanorods follows the c-axis (0001) of their wurtzite crystal structure, with the sidewalls all being m-planes [$(1\bar{1}00)$ family], and thus they are hexagonal in cross-section. Nanorods grown using this method are defect-free monocrystals with interesting mechanical and optical properties.[4-6]

Supplementary References

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3. Ambacher, O. *et al*. *Sol. State Commun.* **1996**, 97, 365-370.
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5. Tanner, S. M.; Gray, J. M.; Rogers, C. T.; Bertness, K. A.; Sanford, N. A. *Appl. Phys. Lett.* **2007**, 91, 203117.
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Supplementary videos

Supplementary Video SV1. Controlling nanorod rotation using holographic optical tweezers. Two infrared optical traps (not visible) at the nanorod ends are used to rotate it by 360^{o}. The rotated nanorod changes *z*-position, unlike the stationary nanorod seen on the right; the focusing plane is continuously adjusted to coincide with the manipulated nanorod. The video speed has been increased by a factor of two.

Supplementary Video SV2. Self-alignment and self-positioning of a nanorod along the singular τ-disclination in the core of a $b=p/2$ edge dislocation. Fragments of movies showing how two optical traps are used to place a nanorod about p/4 beneath a dislocation and then slowly rotate CCW towards the dislocation core. When at an angle of ~45^{o} (after ~32 s into the movie), the nanorod escapes from the optical traps, self-rotates to become parallel to the τ-defect line, and is eventually “sucked” into the disclination.

Supplementary Video SV3. Nanorod-based manipulation of a defect line. Two optical traps moving in opposite directions rotate the nanorod, allowing manipulation of the defect line which follows the orientation of the nanorod. In the end of the movie (~6.5 into the movie) the two traps are blocked and the defect line relaxes back to a straight line. During the relaxation the nanorod is reoriented along with the defect line.

Supplementary Video SV4. Nanorod manipulating a $b=p/2$ dislocation kink. The dislocation kink is displaced by ~10 μm along the edge dislocation as the nanorod is shifted to the left by use of two optical traps.