

Self-diffusion in a macroscopically aligned lyotropic hexagonal phase templated hydrogel

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Lyotropic liquid crystal (LLC) materials (e.g., LLC templated hydrogels [1]) have potential for a wide range of applications such as drug-delivery [2]. Typically the LLC phases (e.g., lamellar and hexagonal) exist as a powder distribution of director orientations, but macroscopically aligned phases can be prepared using external fields (e.g., magnetic fields) [3]. The majority of the applications of these materials are dependent on transport processes and as such characterizing this is pertinent. Self-diffusion (i.e., random translational motion) is the most fundamental form of molecular transport and provides important information regarding the size of a molecule in solution and the environment that the diffusion is occurring in (e.g., as for restricted diffusion) [4–6]. The self-diffusion in macroscopically aligned LLC phases (e.g., lamellar and hexagonal) is anisotropic due to the nanostructures present [6].

The macroscopically aligned lyotropic hexagonal phase of the non-ionic surfactant decaethylene glycol monododecyl ether ($C_{12}EO_{10}$) was used to template a polyethylene glycol diacrylate (PEG-DA) hydrogel and the self-diffusion of water was found to be independent of the diffusion time (up to 3 s) [7]. Initial diffusion tensor imaging results performed ~ 456 days after the sample was prepared indicated that the diffusion anisotropy was retained with storage at ~ 22 °C (Figure 1).

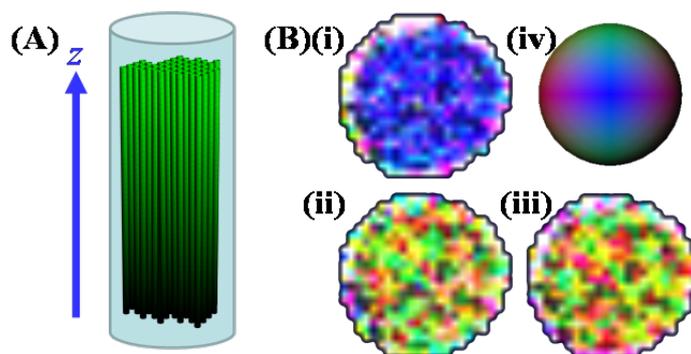


Figure 1: Diffusion tensor imaging results for the self-diffusion of water in a templated hydrogel after storage. (A) Schematic of the alignment in the hydrogel in a 5 mm Wilmad NMR tube. (B) Diffusion tensor images for an axial slice (voxel size: $0.196 \text{ mm} \times 0.196 \text{ mm} \times 0.5 \text{ mm}$ (slice thickness), diffusion time: 70 ms). (B)(i), (ii) and (iii) show images for the first, second and third eigenvectors, and (iv) a directional representation.

References

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