Assembly of Colloidal Rods by Means of DC Electric Fields

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We report the use of an applied DC electric field to produce anisotropic orientational order in micron-sized Brownian colloidal rods with aspect ratio between about three and eight. The suspensions, because of their slow Brownian dynamics, undergo equilibrium self-assembly only on long time scales. Application of an applied DC electric field significantly accelerates the kinetics of assembly. The spatial and orientational structure of the assemblies is imaged in three dimensions using confocal microscopy and quantified by means of image processing. We analyze our results in terms of the underlying electrokinetics of the system as well as connect the observed field-induced orientational order to the equilibrium isotropic-nematic transition predicted for repulsive rods. The results show a change from isotropic to nematic orientation followed by a transition from mobile to glassy dynamics as the DC electric field strength is increased. In addition, we introduce anisotropy in the pair interaction potential to observe its effect on the structure of the rod assemblies.