

Erratum: Orientational Coupling Amplification in Ferroelectric Nematic Colloids [Phys. Rev. Lett. 97, 147801 (2006)]

Fenghua Li, Oleksandr Buchnev, Chae Il Cheon, Anatoliy Glushchenko, Victor Reshetnyak, Yuri Reznikov,
Timothy J. Sluckin, and John L. West

(Received 26 October 2007; published 20 November 2007)

DOI: [10.1103/PhysRevLett.99.219901](https://doi.org/10.1103/PhysRevLett.99.219901)

PACS numbers: 64.70.Md, 77.84.-s, 82.70.Dd, 99.10.Cd

In a recent Letter Phys. Rev. Lett. **97**, 147801 (2006), we reported significant amplification of orientational coupling in a BaTiO₃ ferroelectric nanocolloids liquid crystal. We found that the nematic orientation coupling in nematic mixture MLC-6609 increased by 10% for particle concentrations of 0.2%. A manifestation of the increased orientational order was that the nematic-isotropic transition temperature T_{NI} increased from 90.2 to 128.9 °C when nanoparticles were added to a host. The same formulation of liquid crystal, surfactant, and solvent, but omitting the particles, was tested after heating and vacuuming, and no change in T_{NI} was observed. We regarded this as evidence that the increase in T_{NI} was a result of the added particles. An order of magnitude calculation indicated that the cause of the gain in the orientational order could be the strong electric field produced by the permanently polarized particles.

However, the measured value of T_{NI} in the suspension was larger than the Curie point of BaTiO₃ ($T_{\text{Curie}} \approx 120$ °C). One might expect the permanent polarization should disappear above the Curie point. We therefore sought additional factors that might contribute to the observed giant increase of T_{NI} in the suspension. We find that the process of adding particles to the host to produce the colloids also causes a change in the nematic matrix composition. Specifically, evaporation of the solvent (heptane) from the mixture of MLC-6609, nanoparticles BaTiO₃, and surfactant (oleic acid) at *low pressure* ($P = \sim 0.2$ mm hg), and the elevated temperature ($T = 80$ °C) result in the loss of low molecular weight components of the MLC-6609. This change in composition was confirmed by comparing the IR spectra of untreated MLC-6609 and MLC-6609 obtained after evaporation of a solvent from a solution of MLC-6609 in heptane at $P = \sim 0.2$ mm hg and $T = 80$ °C. High performance liquid chromatography (HPLC) produces the same result. In our original control, the added oleic acid prevented evaporation of the low T_{NI} components. But the nanocolloidal particles bind the oleic acid, allowing the low T_{NI} components to evaporate and increasing T_{NI} in the mixture.

To exclude the decomposition factor on the gain of T_{NI} , we evaporated the solvent from the mixture of MLC-6609 and surfactant at *normal pressure* ($P = 760$ mm hg). IR spectra and HPLC plots confirm that the composition of MLC-6609 in these experiments is identical to the composition of MLC-6609 after evaporation of heptane. Observation in a polarizing microscope shows that the suspension of BaTiO₃ nanoparticles obtained after evaporation of the solvent at *normal pressure* exhibits an increase in T_{NI} of up to 9 °C for particle concentrations of 1%. The contribution due to the particles into the total increase $\Delta T_{\text{NI}} = 38.7$ °C reported in the Letter is thus actually less than 9 °C. The remaining ~ 30 °C increase is due to the loss of the low molecular weight components of the liquid crystal mixture during solvent evaporation.

To summarize, our Letter reported a 38.7 °C increase in the nematic-isotropic phase transition temperature of MLC-6609 doped by 0.2% by weight nanoparticles. But subsequent experiments show that about three quarters of this increase can be attributed to a change in composition of the nematic mixture. However, some 9 °C of the increase is unambiguously associated with the influence of the ferroelectric nanoparticles on orientational coupling. Although this effect is $\sim 1/4$ of the originally reported value in our Letter, it remains a significant effect. However, in order to preclude changes in the composition of the host that confounded our original work, the optimal materials for follow-up studies are single component nematics in which these effects cannot occur.