Effect of Graphite / Graphene Addition to the Liquid Crystal MBBA

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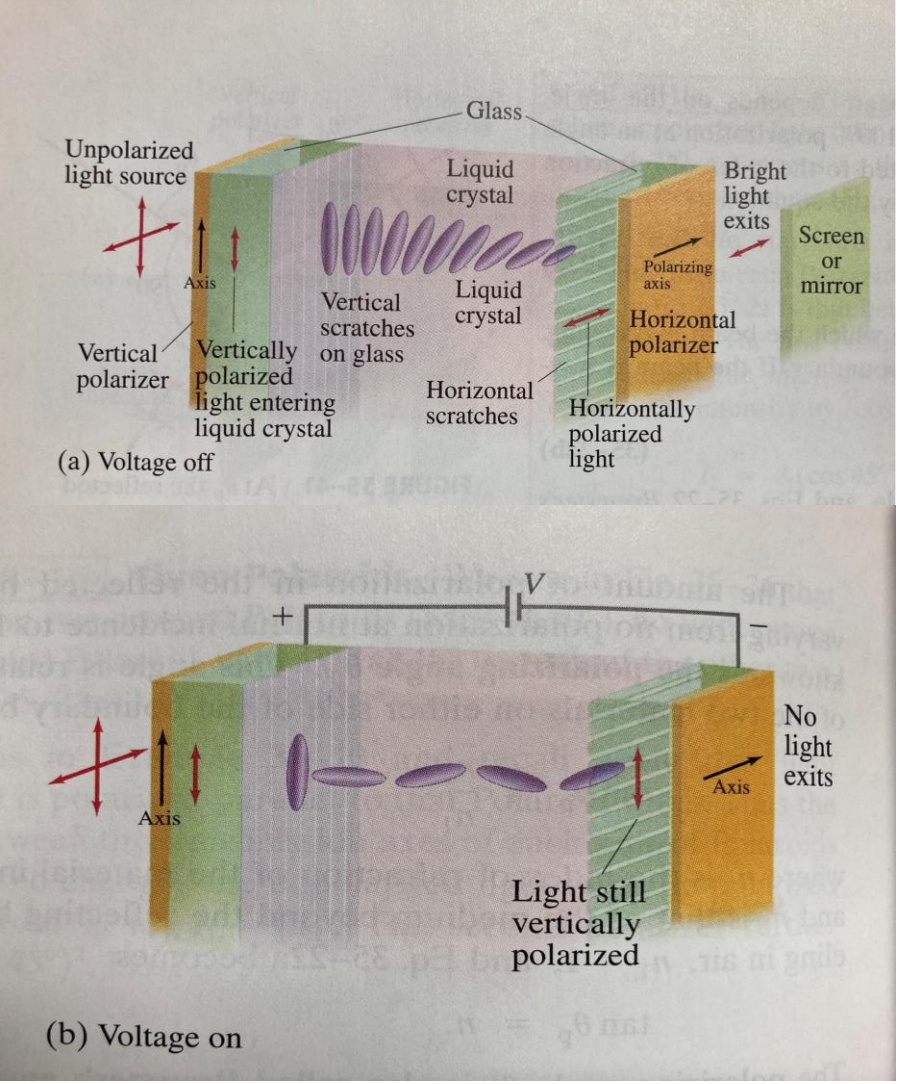

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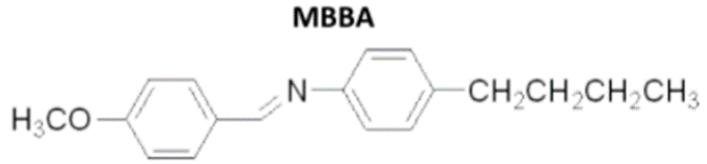
Overview of Liquid Crystals

Liquid Crystals:

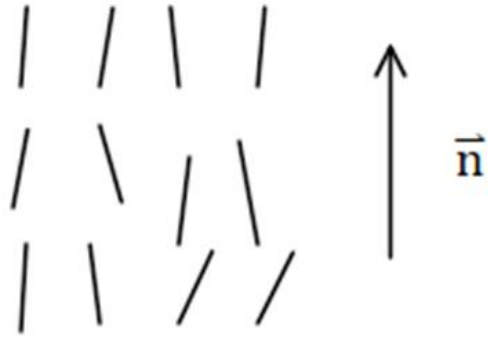
- Composed of long, rod-like molecules in an intermediate phase between liquid and solid
- Anisotropic
- Depolarize light (Electromagnetic Waves)
- Encounter phase transitions at a critical temperature and electric field becoming isotropic
- Used in LCD displays to turn pixels on/off

MBBA

- Nematic
- $C_{18}H_{21}NO$
- Critical temperature about 45°C [1]

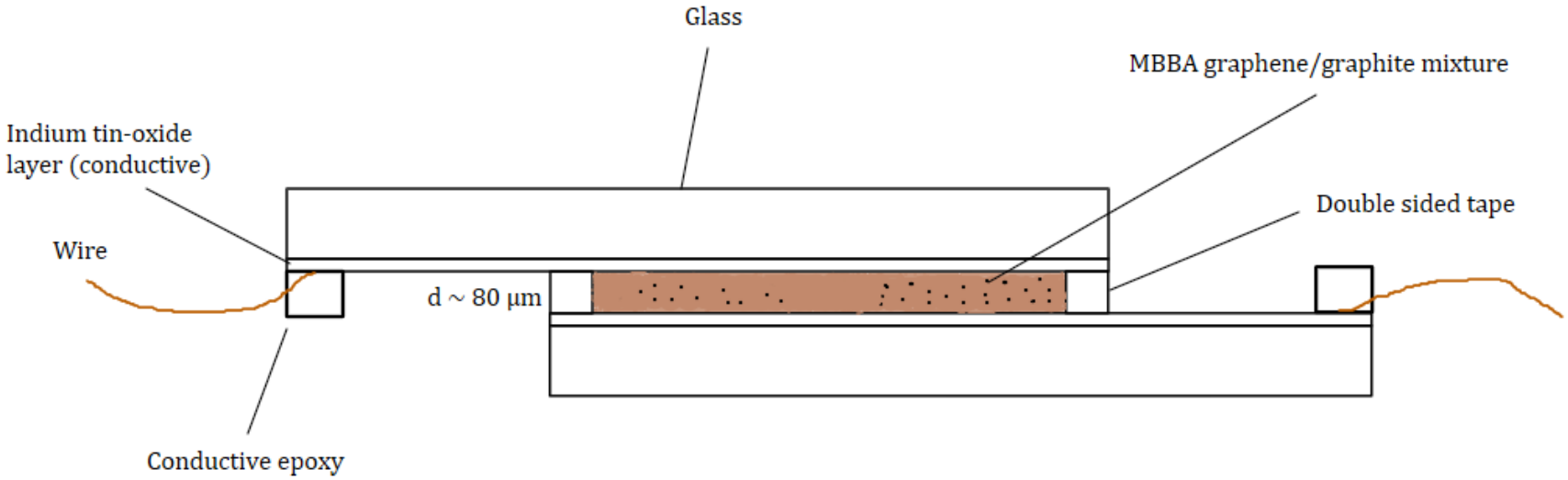


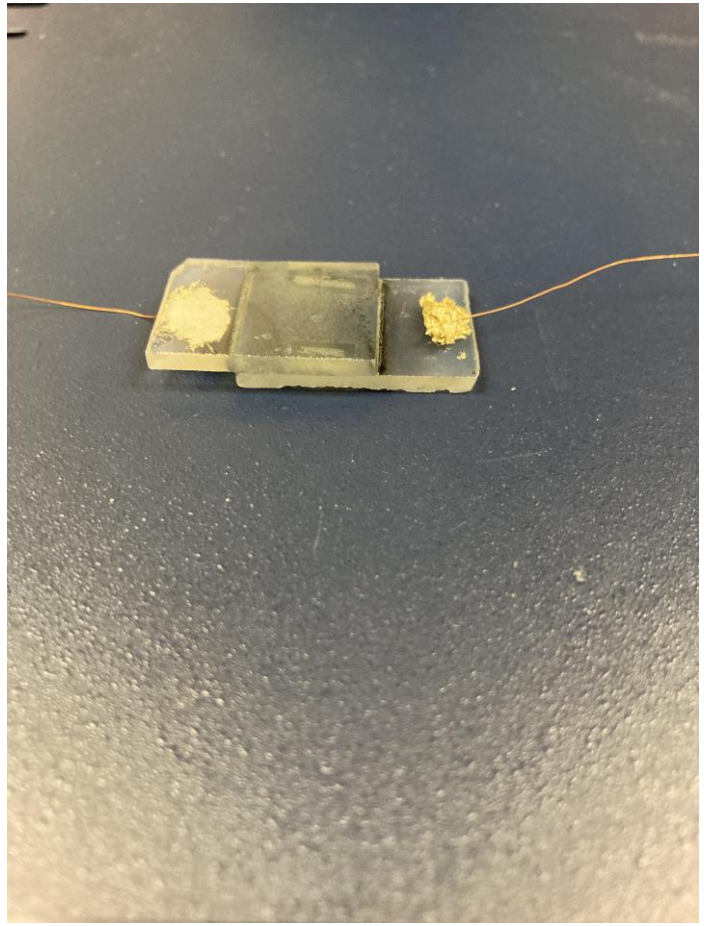
Retrieved from *Thermal Characterization of MBBA, 5CB, and 8CB for Thermal Switches Using the 3ω Method* (p.7), by B. Osiński. 2011.



Nematic

The Sample


Glass
MBBA graphene/graphite mixture
Indium tin-oxide
layer (conductive)
Double sided tape
Wire
d ~ 80 µm
Conductive epoxy

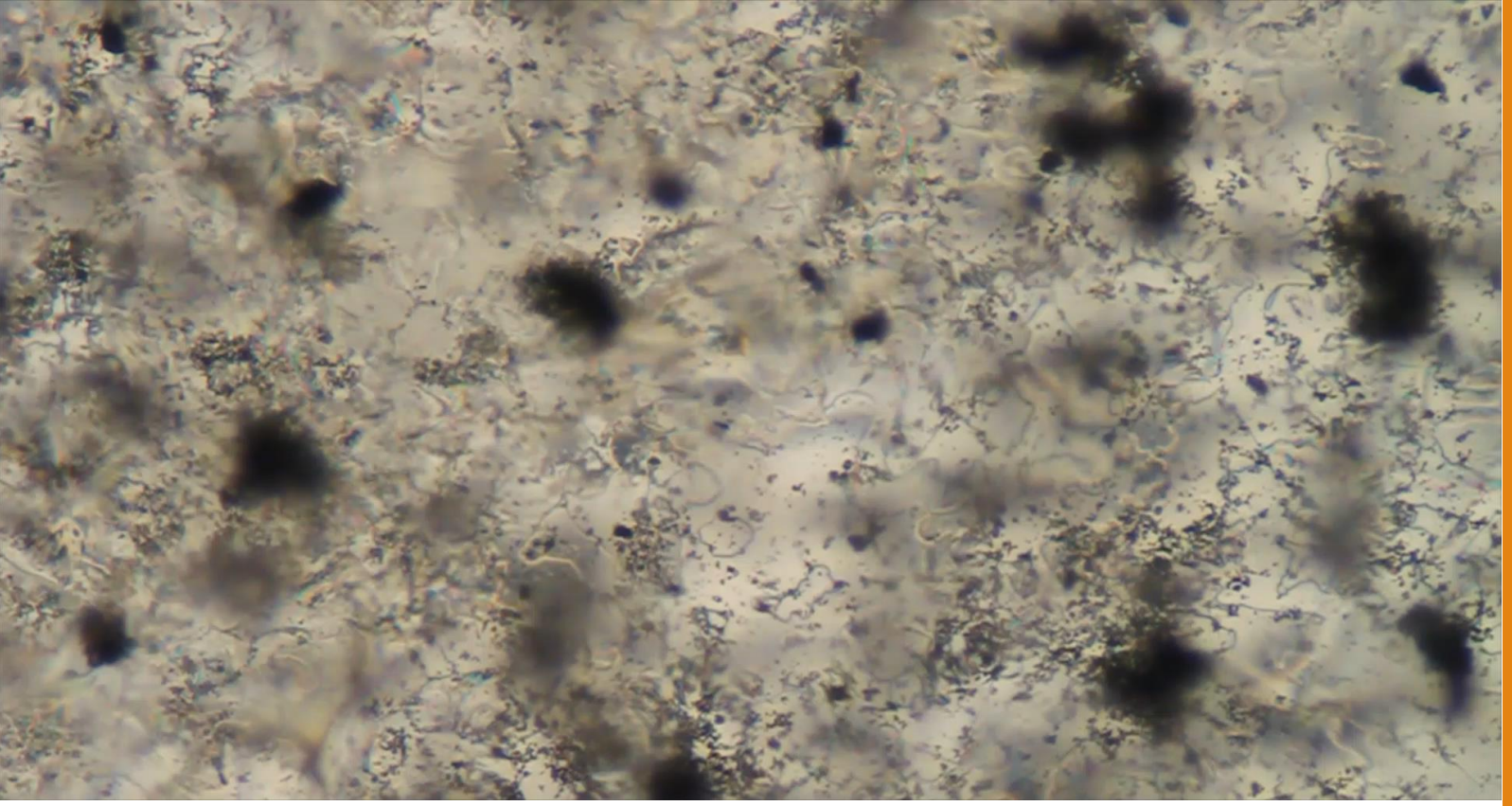


Graphene Exfoliation

Graphite in deionized water

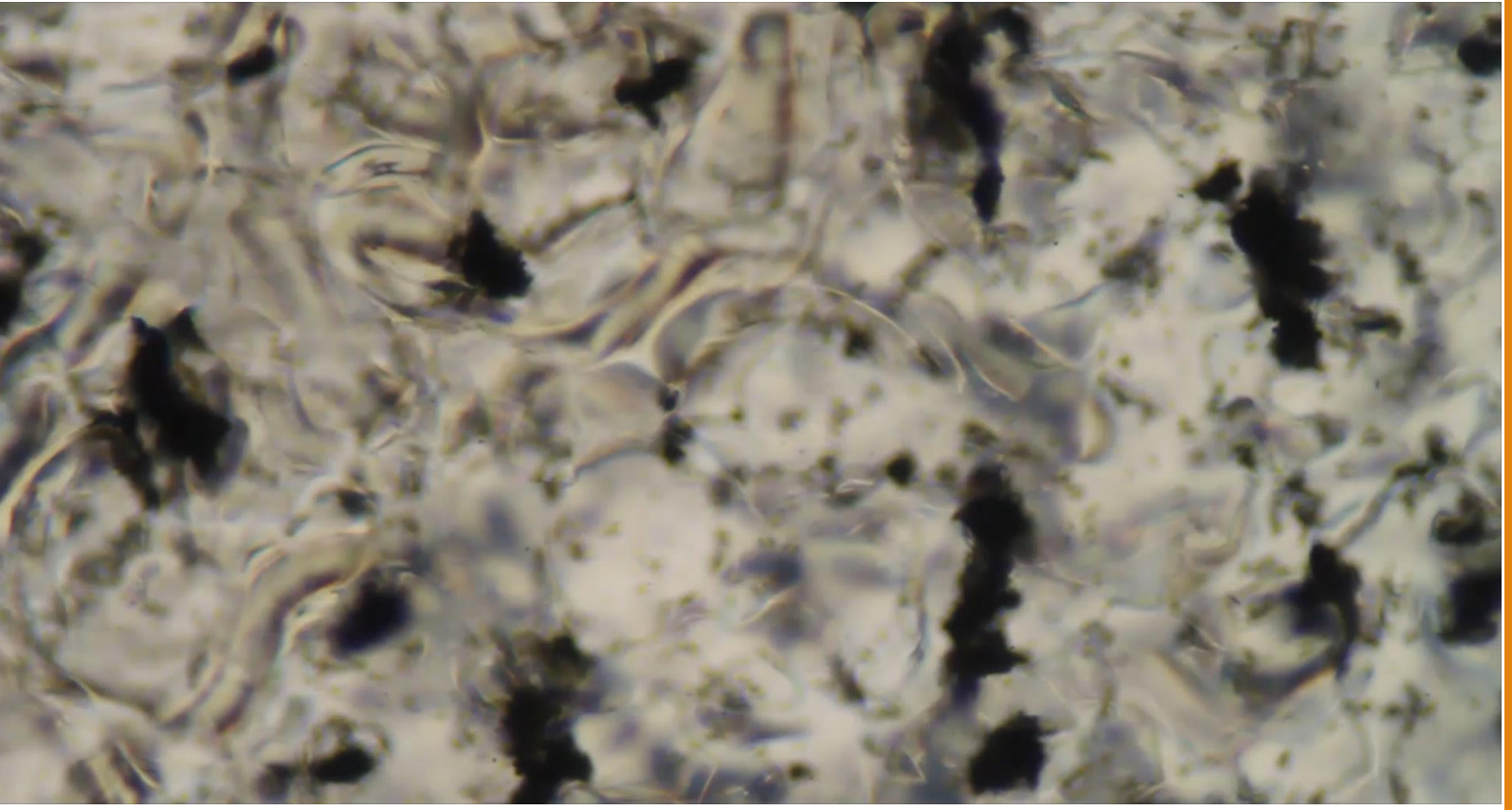
Sonication to create sound waves (phonons) in order to break up graphite into smaller particles

Monolayers of graphite known as graphene, float on surface of water due to density. However, must assume some impurities, thus a mixture of graphene/graphite.



Critical Temperature Phase Transition

Critical temperature upon addition of graphene/graphite estimated to be about 48 °C to 49 °C.



Critical Electric Field

Critical Electric field was obtained when 25.3 V DC were applied across the two glass plates.

Conclusions

Critical temperature of MBBA increased by roughly 5 °C upon addition of graphene/graphite mixture

Voltage to obtain critical electric field dropped significantly upon addition of graphene/graphite mixture. Previously went up to 50 V DC with pure MBBA (no graphene/graphite mixture) and observed no phase transition.

Addition of graphene/graphite to the liquid crystal MBBA aids in energy conservation, requiring less voltage to turn pixels off in LCD displays.

References

1. Osiński, B. L. (2011). *Thermal Characterization of MBBA, 5CB, and 8CB for Thermal Switches Using the 3ω Method* (thesis).

2. Giancoli, D. C. (2008). *Physics for Scientists & Engineers*. Upper Saddle River, NJ: Pearson Prentice Hall.