Seminar

==========

Institute for Plasma Research

==========

Title: Effect of nanomaterials on the dielectric and electro-optical properties of liquid crystals and their applications

Speaker: Dr. Depanshu Varshney
Aligarh Muslim University, Aligarh

Date: 02nd July 2024 (Tuesday)

Time: 03:30 PM

Venue: Online

Joint the talk online: https://meet.google.com/zse-ywqy-tqy

Abstract

Liquid crystals (LCs) are unique materials formed by the self-aggregation of organic molecules and exhibit properties intermediate between conventional liquids and solid crystals [1, 2]. Their versatile electrical, optical, and thermal properties along with their sensitivity to external stimuli, such as electric and magnetic fields, make LCs indispensable in modern technology, from high-resolution liquid crystal displays (LCDs) to smart materials [3]. Even after showing various tremendous properties, LCs are still required to be modified to fulfill specific requirements. For this purpose, the incorporation of nanomaterials, particularly nanoparticles (NPs), is significantly appreciated as they can enhance the performance of LC devices by improving stability, response times, and other physical properties. Experimental investigations of current research works reveal the impact of cobalt oxide (CoO) NPs, bismuth based nanocomposites (NCs), and indium tin oxide (ITO) NPs on the dielectric and electro-optical properties of NLCs. For instance, CoO NPs at a 1 wt% concentration reduce dielectric permittivity and absorbance due to ionic impurities, while bismuth based NCs at 0.1 wt% enhance dielectric anisotropy of 5CB. Additionally, ITO NPs influence the molecular alignment and arrangement of 5CB, with 0.25 wt% resulting in uniform homeotropic alignment and lower clearing temperature. This research work also explores the characteristics of newly formulated FLC materials W377 using techniques such as dielectric spectroscopy, polarizing optical microscopy, and differential scanning calorimetry. Based on our observations, we suggest a completely new mechanism behind a lower-frequency relaxation mode named “Deep Relaxation Mode”. Apart from it, memory effects in smectic A phase of pristine and vanadium doped titanium oxide (VTO) NPs disperse 8CB is also discussed. The discovery of the prolonged memory effect of metastable state in SmA phases of pristine 8CB and biased state in VTO dispersed 8CB presents an exciting avenue for the development of advanced memory devices. These studies will pave the way to devise many systems with NPs as the dopant in order to obtain the desired properties of LC materials.

References:

1. P.P. Muhoray, The diverse world of liquid crystals, Physics Today, 60 (2007) 54.
2. P.G. De Gennes and J. Prost, 1993. The physics of liquid crystals. Clarendon Press.
3. S. Singh, 2001. Liquid crystals: Fundamentals. World Scientific.