

INTISARI

Dinamika Aliran Translasiional pada Fenomena Elektrohdrodinamika Kristal Cair Nematik

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Telah dilakukan penelitian dalam kajian elektrohdrodinamika (EHD) menggunakan sel *parallelepiped* kristal cair nematik (KCN). Penelitian bertujuan untuk menyelidiki secara lebih detail tentang aliran translasiional yaitu pola *Williams Domain* (WD) yang bergerak perlahan dari tepi menuju ke tengah sel. Penelitian ini berfokus pada aliran balik (*backflow*) KCN, aliran pada bagian nonkonveksi sel *parallelepiped*, aliran di bawah tegangan ambang, dan gerak molekul KCN saat terjadi aliran translasiional. Untuk menyelidiki hal tersebut digunakan KCN *N-(4-Methoxybenzylidene)-4-butylaniline* (MBBA) yang didoping dengan *Tetra-n-butyle ammonium bromide* (TBAB) 0,02 % dan dicampur dengan partikel *micropearl*. *Micropearl* dipilih karena dapat merepresentasikan gerak molekul kristal cair. KCN dimasukkan ke dalam sel bergeometri *parallelepiped* dengan ukuran substrat ITO $2,5 \text{ cm} \times 2 \text{ cm}$ dan area pengamatan sebesar $1 \text{ cm} \times 1 \text{ cm}$. Area non-konveksi sel *parallelepiped* diperoleh dengan cara menggeser area pengamatan sebesar $\Delta l = 1 \text{ mm}$ dan $\Delta l = 2 \text{ mm}$. Sampel diberi medan listrik AC berfrekuensi 100 Hz serta dilakukan pengamatan gerak pola dan *micropearl* dengan parameter terganormalisasi $\varepsilon = \left(\frac{V}{V_c}\right)^2 - 1$. Hasil yang diperoleh menunjukkan bahwa kecepatan *micropearl* pada sampel $\Delta l = 1 \text{ mm}$ mengalami kenaikan $\varepsilon = 0,10$ lalu mengalami penurunan pada $\varepsilon = 0,15$. Pada sampel $\Delta l = 2 \text{ mm}$ kecepatan *micropearl* mengalami kenaikan $\varepsilon = 0,05$ lalu mengalami penurunan pada $\varepsilon = 0,10$. Aliran konveksi terjadi lebih awal dari aliran translasiional ditandai adanya gerakan osilasi kecil *micropearl* pada $\varepsilon < 0$. Gerak *micropearl* menunjukkan adanya tiga macam aliran pada sel *parallelepiped* yaitu aliran translasiional, aliran balik, dan aliran konveksi. Hasil perhitungan kecepatan aliran balik (v_b) pada empat tepi sel menunjukkan nilai $163 \times 10^{-3} \mu\text{m/s}$, $110 \times 10^{-3} \mu\text{m/s}$, $134 \times 10^{-3} \mu\text{m/s}$ dan $141 \times 10^{-3} \mu\text{m/s}$. Hasil pengamatan lintasan *micropearl* menunjukkan bahwa saat terjadi aliran translasiional juga disertai pergerakan atau aliran massa kristal cair.

Kata kunci: Elektrohdrodinamika (EHD), aliran translasiional, kristal cair nematik (KCN), sel *parallelepiped*, *N-(4-Methoxybenzylidene)-4-butylaniline* (MBBA)

ABSTRACT

Translational Flow Dynamics on the Nematics Liquid Crystal Electrohydrodynamics Phenomenon

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The study of electrohydrodynamics (EHD) using parallelepiped nematic liquid crystal (NLC) cells has been done. This study aims to investigate in more detail the translational flow, the Williams Domain (WD) pattern that moves slowly from the edge to the center of the cell. This research focuses on the backflow of NLC, the flow in the non-convection part of the parallelepiped cell, the flow under threshold voltage, and NLC molecules' motion during translational flow. NLC N-(4-Methoxybenzylidene)-4-butaniline (MBBA) doped with Tetra-n-butyle ammonium bromide (TBAB) 0.02% and mixed with micropearl was used. Micropearl was chosen because it can represent the motion of liquid crystal molecules. NLC was inserted into a cell with parallelepiped geometry with an ITO substrate size of $2.5 \text{ cm} \times 2 \text{ cm}$ and an observation area of $1 \text{ cm} \times 1 \text{ cm}$. The non-convection area of parallelepiped cells was obtained by shifting the observation area by $\Delta l = 1 \text{ mm}$ and $\Delta l = 2 \text{ mm}$. The sample was given an AC electric field with a frequency of 100 Hz and observed for pattern and micropearl motion with the normalized voltage parameter $\varepsilon = \left(\frac{V}{V_c}\right)^2 - 1$. The results showed that in the sample $\Delta l = 1 \text{ mm}$, the micropearl velocity increased until the value of $\varepsilon = 0.10$, but at $\varepsilon = 0.15$ the micropearl velocity decreased. For the sample $\Delta l = 2 \text{ mm}$, micropearl velocity increased until the value of $\varepsilon = 0.05$ and at $\varepsilon = 0.10$ the velocity decreased again. The convection flow occurs earlier than the translational flow, which is indicated by a small micropearl oscillating motion at $\varepsilon < 0$. Micropearl motion shows that there are three types of flow in parallelepiped cells, namely translational flow, backflow and convection flow. The calculation of the backflow velocity (v_b) at the four edges of the cell show a value of $163 \times 10^{-3} \mu\text{m/s}$, $110 \times 10^{-3} \mu\text{m/s}$, $134 \times 10^{-3} \mu\text{m/s}$ and $141 \times 10^{-3} \mu\text{m/s}$. Observations of the micropearl trajectory show that the translational flow is also accompanied by the movement or mass flow of liquid crystals.

Keywords: Electrohydrodynamics (EHD), translational flow, nematic liquid crystals (NLC), parallelepiped cell, N-(4-Methoxybenzylidene)-4-butaniline (MBBA)