INTISARI

STUDI ANALITIK MODEL HAMILTONIAN TERMODIFIKASI *AD-HOC* SEBAGAI REPRESENTASI DARI SISTEM MATERIAL *TWISTED BILAYER GRAPHENE* DENGAN PENAMBAHAN *DOPANT* PADA FASE SUPERKONDUKTIF DALAM APROKSIMASI BCS KONVENSIONAL

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Struktur pita elektronik material *twisted bilayer graphene* dianalisis menggunakan aproksimasi *tight-binding* kontinu, dengan memodifikasi penambahan parameter tegangan *gate* secara *ad-hoc* pada persamaan Hamiltonian sistem. Diamati bergesernya garis energi Fermi menuju garis pita datar spektrum elektonik (singularitas Van Hove). Tingginya besaran rapat keadaan elektron pada garis energi Fermi akibat potensial *gate* secara langsung menentukan tingginya besaran temperatur kritis fase superkonduktif dari aproksimasi BCS konvensional. Sudut untiran antar lapisan juga turut berkontribusi terhadap besaran rapat keadaan elektron dari sistem secara keseluruhan; sehingga dilakukan analisis terhadap jenis sudut untiran ’ajaib’ superkonduktif $\theta \approx 1.05°$, sudut untiran *Commensurate* $\theta \approx 1.47°$, dan sudut untiran *Non-Commensurate* $\theta \approx 1.50°$. Approksimasi temperatur kritis fase superkonduktif BCS pada variasi potensial *gate* dari 0 meV hingga 5 meV, nilai maksimum T_c dicapai sekitar $V \approx 2$ meV untuk tiga jenis sudut yang berbeda. Posisi yang lebih stabil dari puncak T_c dapat diketahui dari analisa perbedaan selisih kapasitas panas keadaan superkonduktif dan keadaan normalnya, dan terlihat hal ini terjadi disekitar variasi tegangan $V \approx 2.2$ meV. Modifikasi secara *ad-hoc* tidak dapat merepresentasikan penambahan *dopant* pada fase superkonduktif sistem, melainkan merepresentasikan peningkatan energi keseluruhan sistem melalui pergeseran garis energi Fermi.

Kata kunci : *twisted bilayer graphene*, *tight-binding*, tegangan *gate*, *ad-hoc*, energi Fermi, singularitas Van Hove, sudut untiran ’ajaib’, sudut untiran *Commensurate*, sudut untiran *Non-Commensurate*, pasangan Cooper,fase superkonduktif BCS, *dopant*

ABSTRACT

ANALYTICAL STUDY OF MODIFIED AD-HOC HAMILTONIAN MODEL AS REPRESENTATION OF MATERIAL SYSTEM TWISTED BILAYER GRAPHENE WITH ADDITION OF DOPANT ON SUPERCONDUCTIVE PHASE IN CONVENTIONAL BCS APPROXIMATION

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The electronic band structure of the twisted bilayer graphene material was analyzed using the continuous tight-binding approximation, by modifying the addition of the gate stress parameter by ad-hoc in the Hamiltonian equation of the system. It is observed that the Fermi energy line shifts towards the flat bands of the electronic spectrum (Van Hove singularity). The high magnitude of the electron state density on the Fermi energy line due to the gate potential directly determines the high magnitude of the critical temperature of the superconductive phase from the conventional BCS approximation. The twist angle between the layers also contributes to the magnitude of the electron density of the system as a whole; so that an analysis is carried out on the type of superconductive 'magic' twist angle $\theta \approx 1.05°$, the Commensurate twist angle $\theta \approx 1.47°$, and the Non-Commensurate twist angle $\theta \approx 1.50°$. The critical temperature approximation of the BCS superconductive phase at the gate potential varies from 0 meV to 5 meV, the maximum value of T_c is reached around $V \approx 2$ meV for three different angles. A more stable position of the peak of T_c can be seen from the analysis of the difference in heat capacity difference between the superconductive state and the normal state, and it can be seen that this occurs around the voltage variation of $V \approx 2.2$ meV. The ad-hoc modification does not represent the addition of dopant in the superconductive phase of the system, but instead represents an increase in the overall energy of the system through a shift in the Fermi energy line.

Kata kunci : twisted bilayer graphene, tight-binding, gate, ad-hoc, Fermi energy, Van Hove singularity, 'magic' twist angle, Commensurate twist angle, Non-Commensurate twist angle, Cooper pair, BCS superconductive phase, dopant