BALLISTIC TRANSPORT IN ORGANIC SEMICONDUCTOR DEVICES: MODELING AND CHARACTERIZATION

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SYNOPSIS

Recent years have been rapid acceleration in the research and development of organic semiconductor transistors as key components for innovative nanoelectronic devices. The understanding of the unique properties that characterize these potentially high-performance materials holds great promise filling niches not occupied by inorganic devices. The research aim to develop a fundamental-based modeling organic semiconductor field-effect transistors in accordance to the ballistics carrier transport phenomenon. The organic transistor was designed and simulated using Sentaurus TCAD tools and parameter extractions were carried-out using MATLAB. Hoping transport model was used in the simulation. Output and transfer characteristics were obtained to estimate on effects of contact resistance and mobility in organic field-effect transistors (OFETs) in vary temperature range. In the linear region, the model of contact resistance is taken account into the extraction of modified mobility. The modified mobility obtained higher than the common linear mobility, which reflects the ballistics transport. Moreover, a method to estimate the effects of Meyer-Neldel Rule (MNR) for charge transport mobility was investigated at varies temperature range and the mobility is to be found thermally activated with activation energies.

SINOPSIS

Kebelakangan ini, kepesatan kajian penyelidikan transistor berasaskan bahan organik semikonduktor sebagai komponen utama untuk peranti nanoteknologi yang inovatif. Justeru itu, pemahaman ciri-ciri unik bahan berprestasi tinggi ini mampu meluaskan potensi penggunaan dan aplikasi dibandingkan dengan bahan bukan organik. Kajian penyelidikan ini bertujuan untuk membangunkan asas permodelan transistor berasaskan organik semikonduktor mengikut fenomena pembawa angkutan balistik. Transistor berasaskan organik semikonduktor telah direkabentuk dan disimulasi menggunakan TCAD Sentaurus dan parameter-paramater tertentu diekstraksi menggunakan perisian MATLAB. Angkutan Hoping model telah dipilih di dalam proses simulasi. Ciri-ciri elektrik diperolehi untuk menganggarkan kesan rintangan sentuhan dan mobiliti untuk transitor organik (OFETs) dalam julat suhu tertentu. Di kawasan linear, model rintangan sentuhan diambil kira untuk pengekstrakan mobiliti ubahsuai. Mobiliti ubahsuai diperolehi lebih tinggi berbanding mobiliti linear biasa dan ini menunjukkan fenomena angkutan balistik berlaku. Selain itu, kaedah penganggaran kesan Meyer-Nedel (MNR) untuk angkutan pembawa mobiliti telah disiasat di dalam julat suhu yang berbeza dan mobiliti diaktifkan oleh haba dengan tenaga pengaktifan.