UNIVERSITI TEKNOLOGI MARA

5th I-CReST 2025

INTERNATIONAL CONFERENCE ON RESEARCH AND PRACTICES IN SCIENCE, TECHNOLOGY AND SOCIAL SCIENCES

SYNERGY FOR FUTURE SUSTAINABILITY:
BRIDGING SCIENCE, TECHNOLOGY AND HUMANITIES

Abstract Book

UNIVERSITI TEKNOLOGI MARA
CAWANGAN SELANGOR, KAMPUS DENGKIL
MALAYSIA

13th SEPTEMBER 2025

ORGANISED BY: Centre of Foundation Studies

STRATEGIC PARTNER: UiTM Global

IN COLLABORATION WITH: UTM

I-CReST 2025: 087-053 – Effect of Mechanical Processing on the Thermophysical Properties of MgO/Car Radiator Coolant-Based Nanofluid

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ABSTRACT

The continuous demand for enhanced transistor performance in advanced integrated circuits presents major challenges particularly in achieving strong electrostatic control, high carrier mobility, and reduced leakage current. These challenges are critical in the design of field-effect transistors (FETs) where scaling effects can degrade device performance. Two-dimensional (2D) materials, especially transition metal dichalcogenides (TMDs), have emerged as promising channel materials due to their atomically thin structure and favorable electronic properties. This study investigates the suitability of molybdenum diselenide ($MoSe_2$) and molybdenum disulfide (MoS_2) as 2D channel materials for ultra-scaled FETs. Simulations were conducted using the 2D-FET tool on nanoHUB.org by varying key physical parameters including scattering mean free path (mfp), gate oxide thickness (tins), gate insulator dielectric constant (epsr), and gate length while keeping other factors such as the complementary metal-oxide semiconductor (CMOS) type, channel orientation, and temperature constant. Electrical performance was assessed through drain current–gate voltage (Id–Vg) characteristics. Results show that $MoSe_2$ exhibits higher carrier mobility making it suitable for high-speed applications such as processors whereas MoS_2 provides superior gate control and lower leakage, favoring low-power applications. These findings highlight the complementary advantages of both materials in addressing scaling challenges and support their potential for next-generation energy-efficient nanoelectronic devices.

Keywords: Nanofluids; MgO nanoparticles; Car radiator coolant