The effect of external force on the crack propagation of aluminum nanoplate using molecular dynamics approach: Insights into the fracture mechanisms of metallic nanomaterials under external loading condition

Abstract

It is crucial to comprehend how external forces (EFs) affect crack propagation (CP) in aluminum (Al) nanoplates to develop and create nanomaterials with enhanced mechanical characteristics. The creation of novel materials for a variety of uses, such as the aerospace, electronics, and energy sectors, may benefit from this expertise. Additionally, insights into the fracture mechanisms of nanomaterials can aid in designing more reliable and durable structures at the nanoscale. This study utilized computer models to investigate the effect of EFs on fractures in Al nanoplates. The results suggest that an EF can significantly alter CP within nanoplates. The findings provide insights into the fracture mechanisms of metallic nanomaterials under external loading conditions. Simulation results in current research showed the physical stability of modeled Al nanoplates at T=300 K as the initial temperature. Numerically, the total energy (TE) of pristine nanoplate converged to −34762.953 eV after thermodynamic equilibrium detection inside the computational box. Furthermore, the simulation results show that EF caused the crack growth procedure intensity to increase. In the present study, the crack length value increased to 33.902 Å between our modeled samples. This result led to the conclusion that in real-world applications, it is important to consider the effect of EFs on the development of cracks within Al nanoplates.

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