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Molecular dynamics study on initial growth behavior of amorphous carbon film under various incidence angles

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Morphological evolution of amorphous carbon film is investigated by molecular dynamics simulation. Here, energetic carbon atoms (75 eV) are deposited on the diamond (001) substrate to find effect of incidence angles. At normal and near-normal incidences (0^{o}~30^{o}) atomically smooth surfaces are observed during their growth. However, rough surfaces emerge and develop into a ripple structure at grazing incidences (60^{o}～70^{o}). The different growth modes according to the incidence angles can be described by impact-induced displacements of atoms. Downhill transport along any sloped surfaces is predominant for the case of normal incidence. As the incidence angles become grazing, uphill transport is allowed along the surfaces, which have smaller slopes than incidence angle, so the surface features can be amplified. Impact-induced transport and self-shadowing effect can be responsible to the initial growth of seeding structures at a grazing incidence, which would be grown up as tilted columnar structures in further depositions.

Keywords: Surface growth, Molecular dynamics, Amorphous carbon