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Quasi-2D nanostructures: Growth in low-temperature plasmas
EUGENE TAM, IGOR LEVCHENKO, KOSTYA (KEN) OSTRIKOV, AMANDA RIDER, SERGEY VLADIMIROV, Plasma Nanoscience, The University of Sydney, SHUYAN XU, NIE and Institute of Advanced Studies, Nanyang Technological University — Quasi-two-dimensional nanostructures, such as nanowalls, are currently the subject of enormous research interest. Gas-based synthesis methods follow either a neutral- or ionized gas (plasma)-based route to fabricate structures of reduced dimensionality [1]. Here, we present a multiscale hybrid numerical simulation which demonstrates the superiority of the plasma route in controlling the morphology of quasi-two-dimensional surface nanopatterns. It was found that the nanowall width uniformity was the best in high-density plasmas, becoming more non-uniform in lower-density plasmas. The neutral gas-based process resulted in the worst nanowall width uniformity. This effect is the result of the focusing of ion fluxes by irregular electric fields in the vicinity of the plasma-grown nanostructures on a biased substrate, and the differences in the 2D-adatom diffusion fluxes in the ionized gas and neutral gas-based processes. Our simulation results are in good agreement with available experimental results concerning the effect of plasma process parameters on the sizes and shapes of relevant nanostructures. [1] K. Ostrikov, Rev. Mod. Phys. 77, 489 (2005); K. Ostrikov, A. B. Murphy, J. Phys. D: Appl. Phys. 40, 2223 (2007)

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