SEMINARIO

Ion Irradiation Induced Highly Periodic and Crystalline Semiconductor Nano-patterns: Reverse Epitaxy to Erosion Kinetics

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In recent era of device miniaturization, ordered arrays of crystalline nanostructures in large areas on semiconductor surfaces are essential [1]. Here, I show the fabrication of highly crystalline and ordered nanostructures on Si(100) [2], Ge(100) [3] and GaAs [4] surfaces by single step ion beam sputtering (IBS) technique by easy tuning of processing of different process parameters. Due to substrate rotation 5 rpm during 500 eV Ar^+ ion irradiation at grazing incidence 75°, Si surface shows hexagonally ordered pure and crystalline nanodots [2]. While Ge surfaces show crystalline four-fold symmetric checkerboard patterns due to normal incidence 30 eV Ar^+ ion irradiation [3]. For similar condition of irradiation as Ge surface, GaAs surfaces show anisotropic nanoripples [4]. These ripples show independent behavior with ion flux but coarsen with ion energy [5] and become highly regular and nearly defect-free for 1 keV ion irradiation. Pattern formation at room temperature can be explained by the competition effect between curvature dependent ion erosion and surface diffusion processes [6], whereas, the temperature induced nanostructures is attributed to the biased diffusion of vacancies or adatoms arising from ES barrier [7, 8].

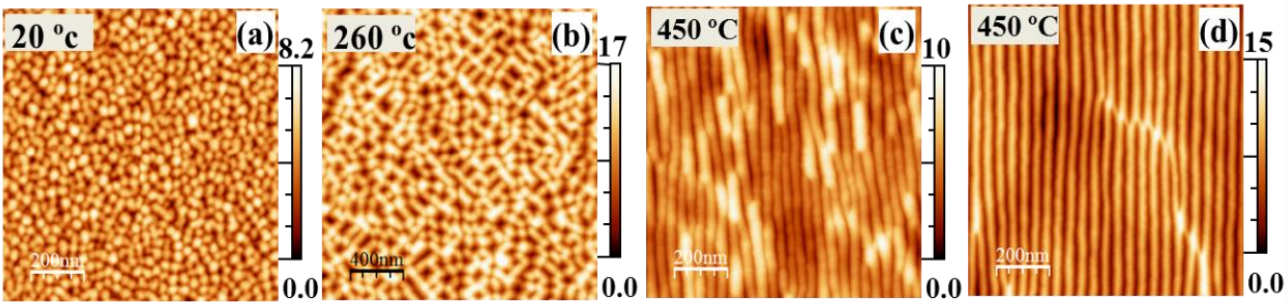

Fig. 1. AFM micrographs of (a) Si, (b) Ge and (c, d) GaAs surfaces sputtered for ion fluence (a) 4.75×10^{18} ions.cm $^{-2}$, (b, c) 1×10^{19} ions.cm $^{-2}$, (d) 5×10^{19} ions.cm^{-2} respectively. The height scales are in nm.

References

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