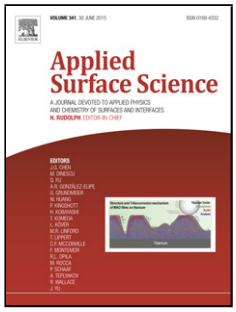


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# Thermally controlled growth of surface nanostructures on ion-modified AIII-BV semiconductor crystals

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**Highlights**

- A *sample temperature influence on the pattern formation, under $Ar^+$ ion beam sputtering,* is extensively elaborated.
- Thermal surface diffusion of mobile adspecies acts substantial contribution for evolution of pillar-like structures.
- Formation of stable self-masking clusters, and effectively their further growth, is temperature dependent.
- Redeposition is proposed to be self-driven mechanism when higher and higher structures are formed.

The primary motivation for our systematic study is to provide a comprehensive overview of the role of sample temperature on the pattern evolution of several AIII-BV semiconductor crystal (001) surfaces (i.e., InSb, InP, InAs, GaSb) in terms of their response to low-energy $Ar^+$ ion irradiation conditions. The surface morphology and the chemical diversity of such ion-modified binary materials has been characterized by means of scanning electron microscopy (SEM). In general, all surface textures following ion irradiation exhibit transitional behavior from small islands, via vertically oriented 3D nanostructures, to smoothened surface when the sample temperature is increased. This result reinforces our conviction that the mass redistribution of adatoms along the surface plays a vital role during the formation and growth process of surface nanostructures. We would like to emphasize that this paper addresses in detail for the first time the topic of the growth kinetics of the nanostructures with regard to thermal surface diffusion, while simultaneously offering some possible approaches to supplementing previous studies and therein gaining a new insight into this complex issue. The experimental results are discussed with reference to models of the pillars growth, abutting on preferential sputtering, the self-sustained etch masking effect and the redeposition process recently proposed to elucidate the observed nanostructuring mechanism.

***Keywords:*** *ion-induced surface nanopatterning , nanostructures, ion irradiation, thermal surface diffusion, SEM, AIII-BV semiconductors*

## *1. Introduction*

Special attention has been drawn of late towards the synthesis of nanostructures such as nanodots, nanotubes and nanowires on AIII-BV semiconductors [1-4]. In particular, the fabrication of regular vertically aligned semiconductor nanowire arrays with a precisely defined height and width is of enormous scientific and technological interest. Semiconductor nanorods with a high aspect ratio