



Embedded Nanofibers Induced by High Energy Ion Irradiation of Bulk GaSb

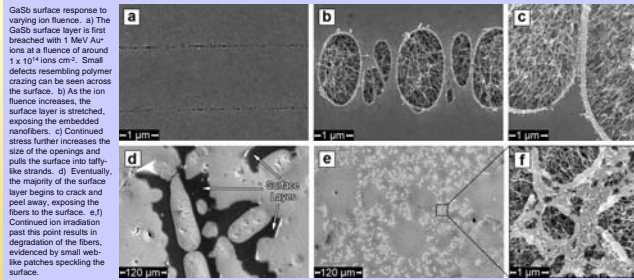
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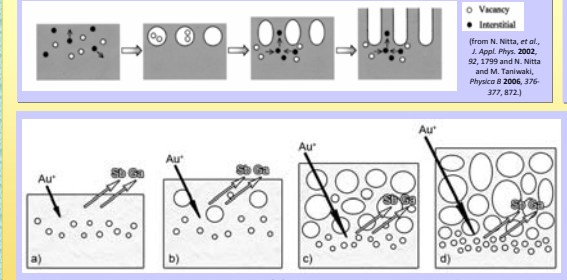
Introduction

- Ion irradiation can be used to fabricate self-organizing nanostructures in a variety of semiconductor materials.
- Other nanofabrication methods, such as molecular deposition or etching techniques, are only capable of producing surface structures, either by top-up or top-down approaches.
- Ion irradiation is capable of fabricating *embedded* structures.
- In the semiconductor gallium antimonide (GaSb), ion irradiation creates relatively uniformly spaced, uniformly sized nanofiber layers. Embedded fiber layers can be fabricated with high energy ions.
- By varying the ion implantation conditions, it is possible to tailor the various properties of the fiber layer.

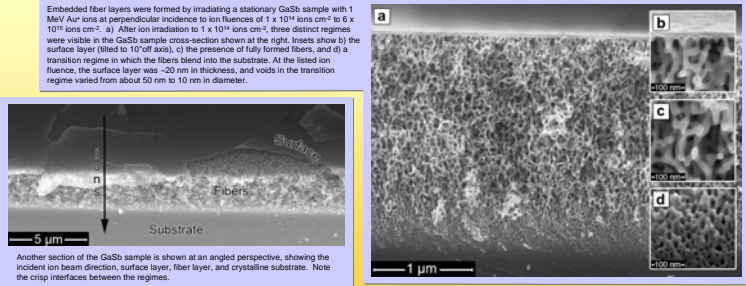
Surface Layer Response



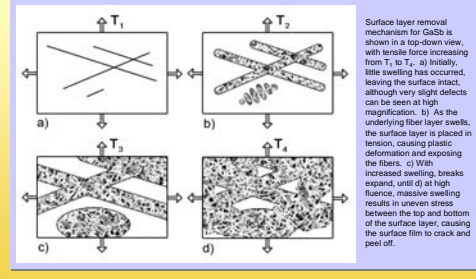
Fiber Formation Mechanism



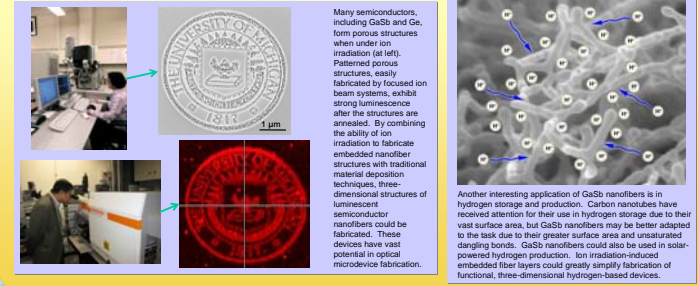
Embedded Fiber Layer Regimes



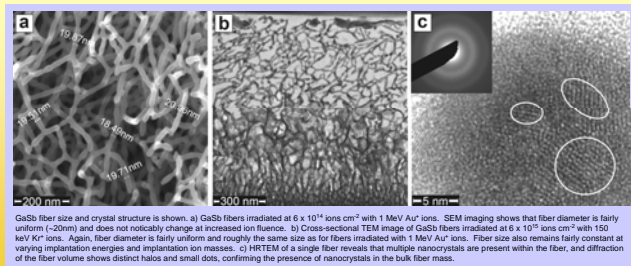
Surface Layer Removal Mechanism



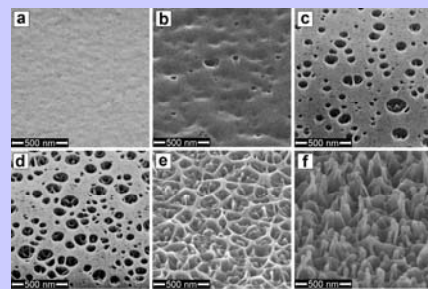
Modern Applications of Embedded Nanofibers



Fiber Size and Crystallinity



Porosity Formation Mechanism



Conclusions

- Ion irradiation can be used to fabricate uniform nanofibers in GaSb
- Fiber layer properties can be tailored by adjusting implantation parameters
 - Fiber layer thickness is proportional to ion fluence
 - Fiber formation depth is proportional to ion mass and energy
 - Surface layer response is a function of sputtering yield and volume swelling of the fiber layer
- Embedded nanofibers can be produced, with applications in the fabrication of three-dimensional optical microdevices and MEMS

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