Micro-nano manufacturing and modification of materials by use of highly-charged ion beams

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Objective

In the field of nanotechnology, it is important to fabricate or modify the surface of materials within micro-nano meter scale. In this project, such fabrication and modification methods are investigated by use of highly-charged ion (HCI) beams. Applying high reactive [1] and highly efficient acceleration of HCI beam, PhD candidates are expected to develop more efficient or unique fabrications/modifications.

Project Outline

(1) Review of past investigations

A. HCI effect in ion beam lithography was observed as an enhancement of etching depth of Spin-on-Glass. [2]

B. Effect of irradiation on nanohardness of single crystal Si enhanced by irradiation of HCI beam. [3]

C. Swelling structure of Si crystal induced by ion beam irradiation. [4]

(2) Facilities and apparatus used in this project

In order to prepare and irradiate HCI beam, the facility built at KUT is used. This facility includes an ECR ion source, which can prepare highly charged ions with high intensity compared with other ion sources. This facility is conducted by our research group. In order to examine irradiated materials, we can utilize various kinds of common apparatus, including AFM, SEM.

(3) Themes to be investigated

A. Fabrication of micro-nano scale 3D structures

B. Modification of mechanical and electromagnetic properties of surface

C. Control of mobility of impurity and defects in materials

D. Interaction between HCI beam and materials

(4) Collaboration

We work in collaboration with several research groups from other universities and institutes. These collaborations are aimed at the study of not only nanotechnology but also basic sciences. SSP students can join these collaborations.

References

[1] U. Kentsch et al.: Slow highly charged ions for nanoscale surface modifications, Nucl. Inst. Meth. B 216 (2004), pp. 196-201.

[2] S. Momota et al., H. Ohno: Application of Highly Charged Ar Ion Beams to Ion Beam Lithography, Nucl. Instr. Meth. B 242 (2006), pp.247-249.

[3] S.A. Pahlovy, Dr. thesis.

[4] J.Zhang et al. : Swelling and annealing phenomena of Si crystal irradiated by Ar and C ion beams, Nucl. Instr. Meth. B 282 (2012), pp.17-20.

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