I. Introduction

- In recent years, the formation of nanostructures on semiconductor surfaces has attracted much interest due to their potential for applications in low-dimensional devices, particularly as ordered quantum nanodots for optoelectronics and quantum devices.
- Low energy ion sputtering using inert gases such as argon has been shown to be a promising non-lithographic, and hence simpler technique for the formation of surface nanostructures.
- Low energy argon ion sputtering has been used to form highly ordered self-assembling nanodots on GaAs, InP and Si(100) surfaces.

II. Objective

- Formation of self-organized ordered nanodots array on InP(100) surface by rastered Ar+ beam sputtering at normal incidence.

III. Experiment

- Substrate : InP(100)
- The experiments were performed in VG ESCA MkII/SIMSLAB with EXOS sputtering gun under the following conditions:
  - Ion Beam : 1 keV Ar+
  - Incidence angle : Normal
  - Raster Size : 2.57 x 3.35 mm²
  - Stage temperature, T = -110 °C, 23 °C and 36 °C.

IV. Results and Discussion

A. Dependent of nanodots formation on experimental conditions

1. Sputtering time

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  - \( \mu = 23.3 \, \mu \text{A cm}^2, T = 23 ^\circ \text{C} \)

2. Ion current density, \( j_{\text{ion}} \)

- (a) \( j_{\text{ion}} = 5.0 \, \mu \text{A cm}^2 \)
- (b) \( j_{\text{ion}} = 11.6 \, \mu \text{A cm}^2 \)

3. Temperature

- (a) \( T = -110 ^\circ \text{C} \)
- (b) \( T = 23 ^\circ \text{C} \)

Fig. 2. 3 \mu m x 3 \mu m AFM image of InP(100) surface sputtered by 1 keV Ar+ beam with different ion current density. Insets are the self-correlated image of 1 \mu m x 1 \mu m AFM image.

- Ordering of the nanodots array increases with the increasing of ion current density (ion flux).
- A highly regular hexagonal pattern is formed at 23.3 \mu A cm².

- After 7200 s of sputtering, a hexagonal ordered nanodots array increases and height of nanodots.
- Saturation of lateral size and height of nanodots.
- The lateral size and height of nanodots increases and formation of hexagonal array.

B. SEM and in-situ XPS analysis

Fig. 4. (a) In 3d\text{XPS} spectra, (c) Secondary electron image (SEI) and (d) Backscattered electron composition image (COMPO) of nanodots array formed under 23.3 \mu cm², 1 keV Ar+ beam sputtered for 7200 s.

IV. Conclusions

- Ordering of the nanodots formed under Ar+ sputtering of InP(100) strongly dependent on experimental conditions such as temperature, ion flux, sputtering angle and sputtering duration.
- The nanodots surface are In-rich due to the preferential sputtering of P atoms.
- Using scaling theory, the evolution of the sputtered surface can be fitted into two different regimes: coarsening in the early-time regime and ordering in the late-time regime.

V. References