



TMT4320 Nanomaterials, fall 2015

## EXERCISE 9

**Guidance:**

Wednesday 28<sup>th</sup> October, 18:15-20:00, H3

**Due date:**

Friday 30<sup>th</sup> October, 14:00, boxes outside R7 or on It's learning

### PROBLEM 1

- Describe the three growth modes for growth on a substrate.
- How do the interface energy and the surface energies of the substrate and the adsorbate influence the morphology of the growing structures?
- Which growth mode is observed in the growth of InAs quantum dots on GaAs by molecular beam epitaxy? Is this growth mode ideal for the use of quantum dots in intermediate band solar cells? Why/why not?

### PROBLEM 2

You are given a task to produce core-shell nanowires where the core is supposed to be a single crystalline nanowire of Ge with diameter between 5-10 nm and the shell should consist of amorphous silica ( $\text{SiO}_2$ ) with a thickness of 1-2 nm.

- Describe how you would achieve this product. Which technique(s) would be most suitable to obtain this type of nanostructure. Describe all the necessary steps required in the synthesis procedure.
- What would you do if you were asked to produce a crystalline silica shell rather than an amorphous shell? Consider whether this modified procedure would affect the structure and/or morphology of the core in any way.

### PROBLEM 3

Using the nanowires produced in problem 2, and assuming that they have uniform length of about  $2\text{ }\mu\text{m}$ , describe a method that can be used to organize these nanowires into ordered arrays on a substrate. You want the nanowires to be aligned with the axis parallel to the substrate. One suggested pattern could be as shown in the figure below.

