Direct fabrication of gratings on ridge laser structures using focused bismuth ion beams

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Distributed Feedback (DFB) lasers are an essential component in long range data communication systems. In order to create these devices a regrowth process is often required. In such a process an epitaxial growth stage is interrupted to define the grating near the active region. This regrowth process is costly and may increase defects in the device, therefore efforts have been made to eliminate this step. One of the most promising ways to remove regrowth is the utilisation of a laterally coupled (LC) grating structure[1]. These structures can be patterned with e-beam lithography, then etched into the material in one step. One way of removing the requirement for EBL and extra etch steps is to directly pattern the grating using a focused ion beam.

Focused ion beams can be used in nanoscale science and technology for direct nanofabrication (directly patterning materials), resist based processes[2] or for ion beam microscopy[3]. In this work, we demonstrate on and off-ridge gratings directly patterned utilising focused bismuth ions created using a Liquid Metal Alloy Ion Source (LMAIS), a versatile FIB source technology capable of delivering various ion species[4] Figure 1 shows a 1st order on-ridge grating designed for optical feedback at 1550nm patterned on a 3um wide ridge at a depth of 1.7um. The fabricated grating shown has a pitch of 238 nm and a duty cycle of approximately 0.9. It is expected that similar gratings with this type of configuration would provide the necessary coupling for single mode lasing at a cavity length of 300um. In this talk we will outline the details of directly fabricating such gratings and will highlight potential future methods and applications.

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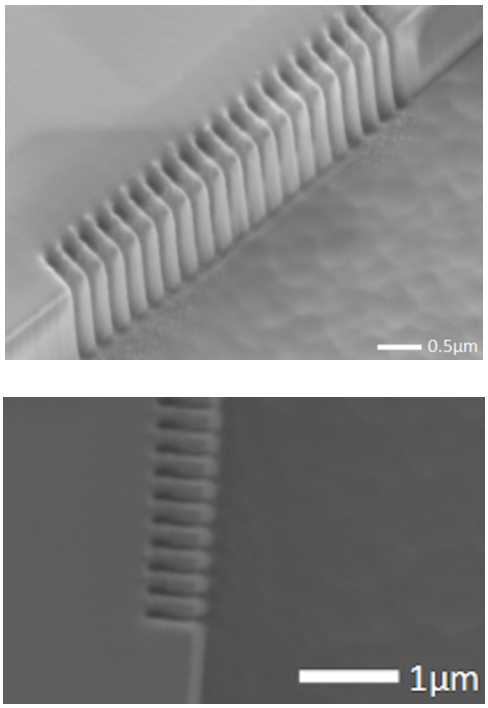

Figure 1: SEM images of a 1st order grating designed for optical feedback at 1550nm patterned on a 3um wide ridge at a depth of 1.7um. The fabricated grating has a pitch of 238 nm and a duty cycle of approximately 0.9.