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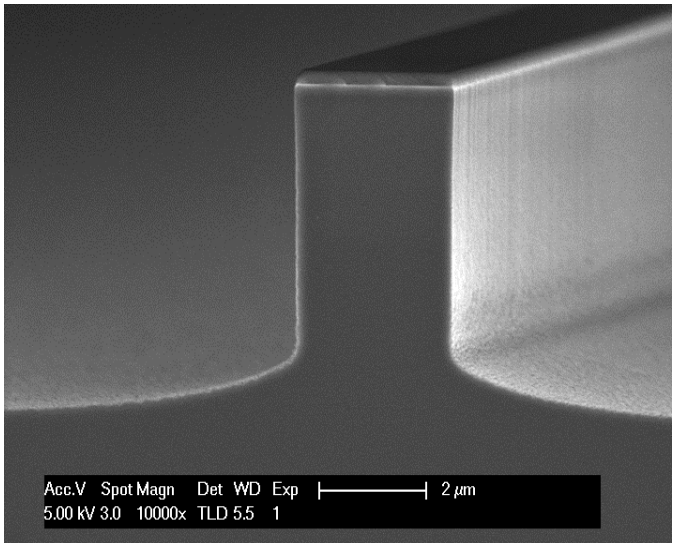
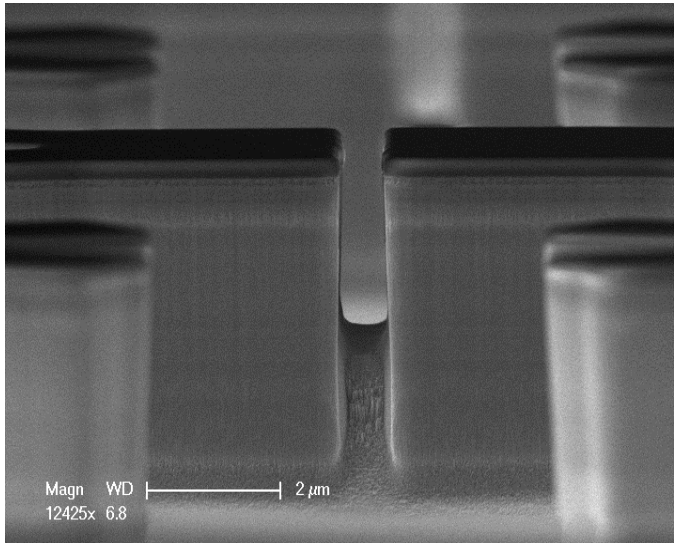
Dry Etching of InP-based Materials using $Cl_2/H_2/Ar$ Chemistry

It is desired that the etch profile of InP-based material is a square shaped. However, it is not always the case: in some cases, micro-trench and bowing appear in etched structures, which are due to the ion deflection caused by the ion and electron re-distribution within the structures. One way to eliminate (or reduce) the angular redistribution of the charges is to add a hydrogen gas into the plasma and create H^+ ions to neutralize the excess electrons on the side-wall. Here, with the use of Unaxis ICP etcher at a chuck temperature of 200 C in Nano-fabrication Lab of UCSB, an Cl2/H2/Ar etch-chemistry recipe was developed by Prof. Larry Coldren's group (see Figure 1), to obtain an etch profile with no such micro-trench and bowing.

Figure1 (a) and (b). InP (InGaAs) etch profile with the etch condition of $Cl_2/H_2/Ar$ flow-rate=7.4/11.6/2 sccm, pressure = 1.5 mTorr, Bias/ICP power=125/800 W. The etch rate is 15-20 nm/s for InP and 7-10 nm/s for InGaAs (copied from Dr. Scott Nicholas's report) .

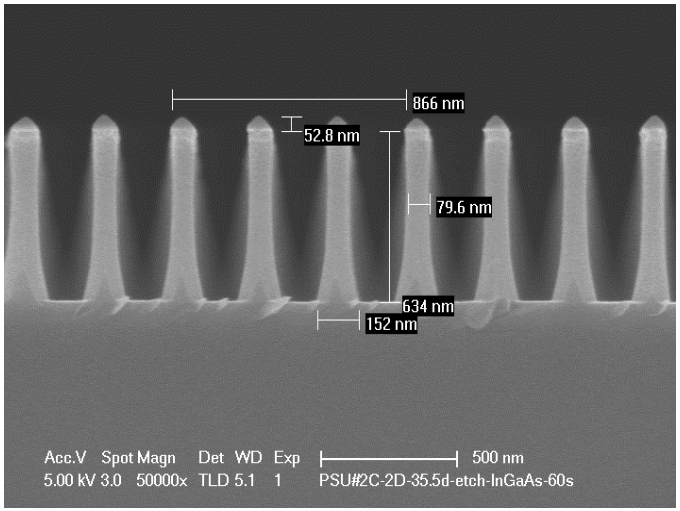


(a)

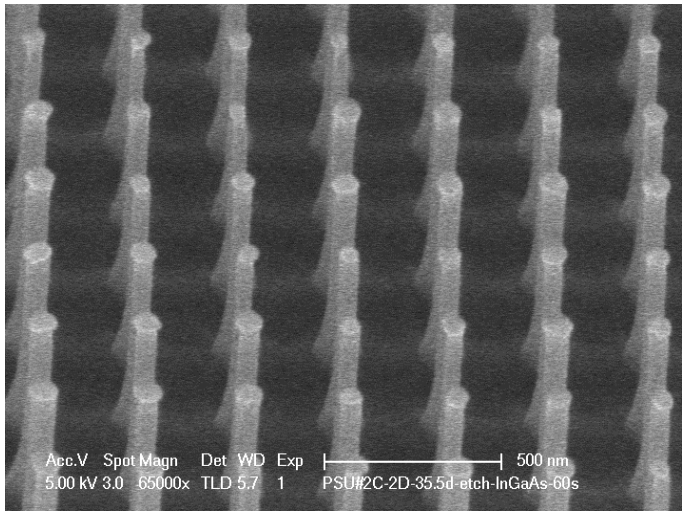


(b)

Figure 2 (a) and (b). Etch profile of InGaAs/InP nano-wire using the recipe mentioned in Figure 1 (etch time=60s).

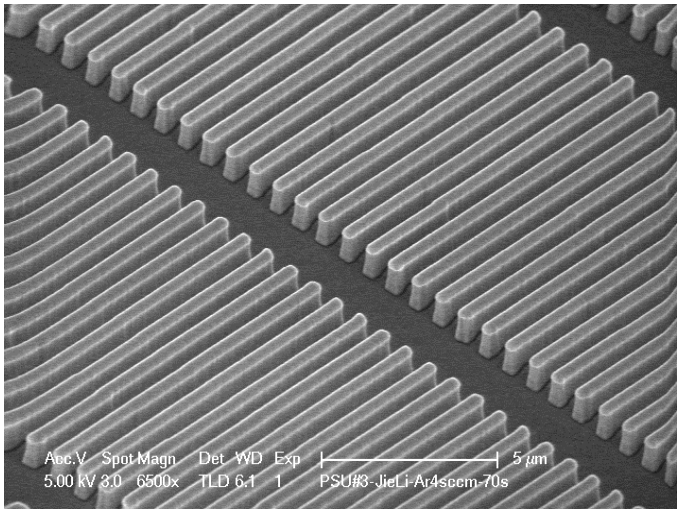


(a)

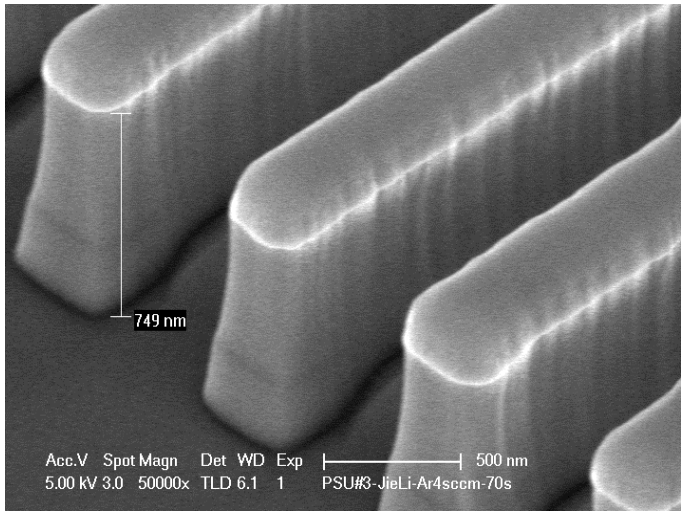


(b)

Figure 3 (a) and (b). Etch profile of InGaAs/InP nano-slab arrays (the etch condition: 1.4mT, 125/800W, Cl2/H2/Ar flow-rate=7.4/11.6/4sccm, and etch time=70s).



(a)



(b)

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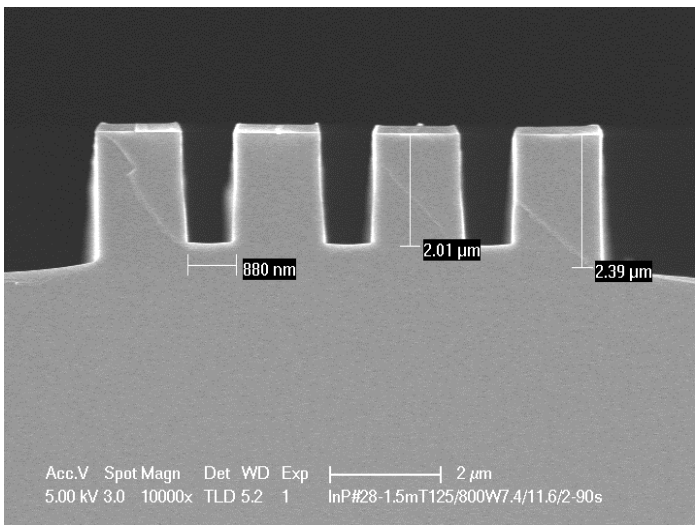
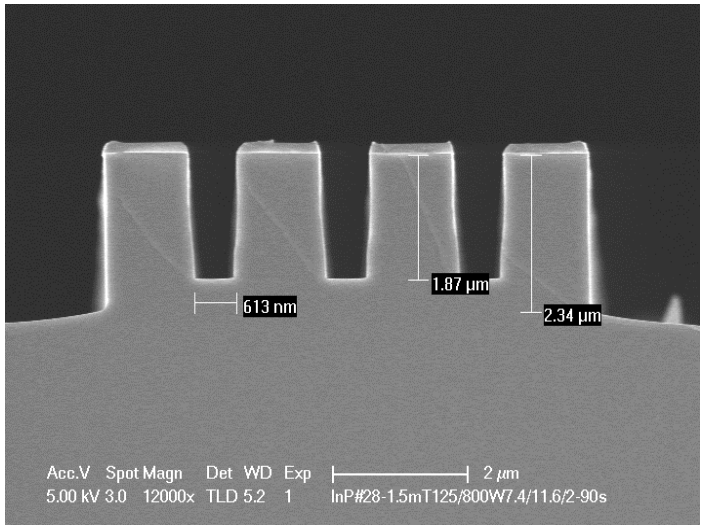
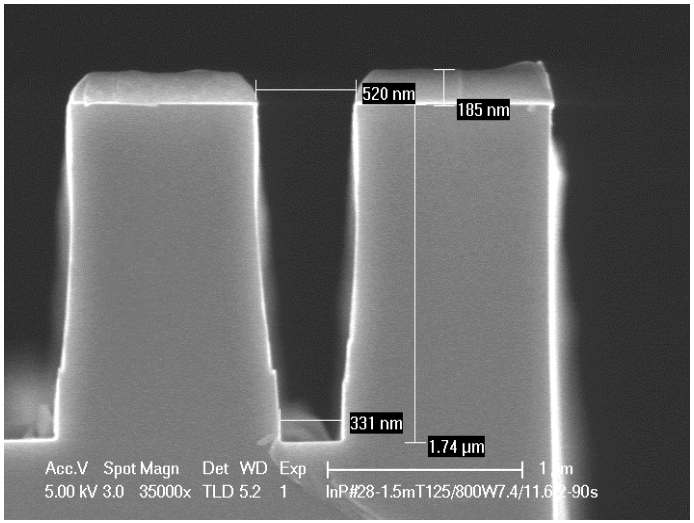
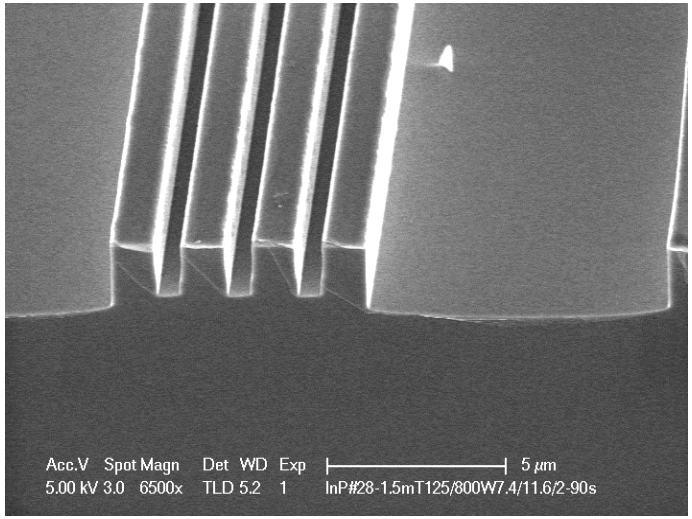
Figure 4 (a)-(f). InP etch profile (the etch condition: 1.5mT, 125/800W, Cl2/H2/Ar flow-rate=7.4/11.6/2sccm, and etch time=90 s).

The open-area etch rate and selectivity (InP/SiO_2) are 1.57um/min and 15.5, respectively.









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