Revolutionizing Semiconductor Scaling with Atomic Layer Etch Pitch Splitting

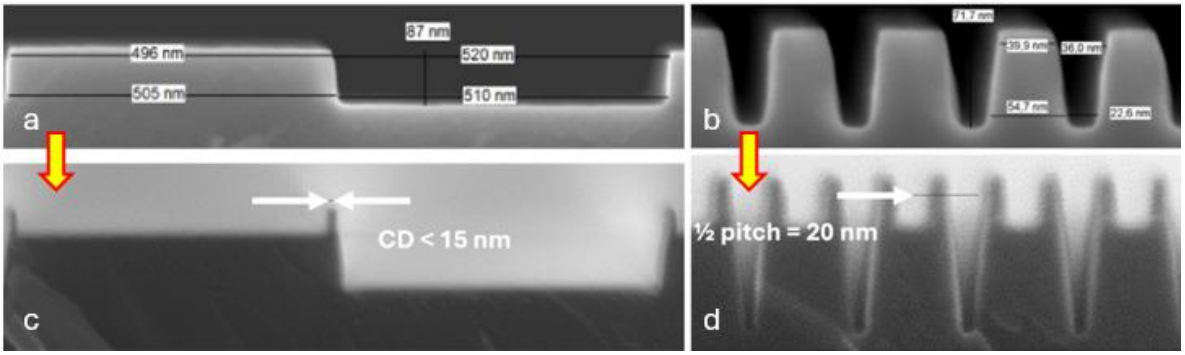

Figure 1. Cross-sectional images of a 90 nm tall a-Si line defined by EBL on a 300-mm wafer after pattern transfer and mask removal a) 500 nm width and 500 nm half-pitch; (b) 40 nm width and 40 nm half-pitch; (c) feature shown in a) after APS, depicting a CD < 15 nm and (d) feature shown in b) after APS, demonstrating a half-pitch of 20 nm. These results confirm that the CD of fins is independent of the original line width.

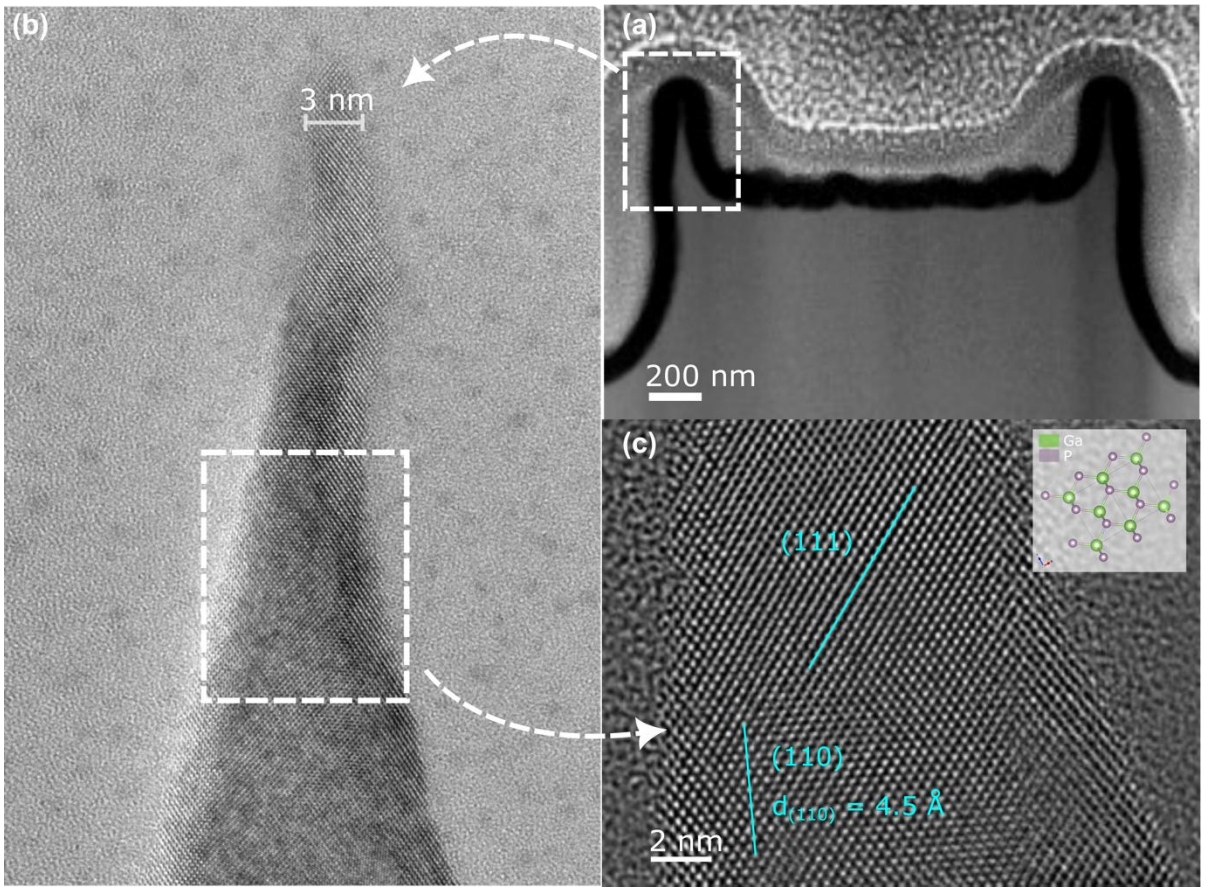

Figure 2. a) Cross-sectional scanning transmission electron microscopy (STEM) image of a GaP line after APS. A (001) GaP wafer was exposed by EBL and the pattern was transferred to the wafer by use of dry etching. All mask material was removed prior to APS process. After APS and to improve material contrast, a layer of SiO_2 was deposited on top of the GaP surface, which appears as dark border around the fins. An HRTEM image of the left-hand fin (from 2(a)) is shown in image b) demonstrating 3 nm CD at the top. (c) magnified HRTEM of the fin with different crystal plane indices for GaP. The inset shows a schematic of the zinc blende structure of GaP. This image clearly shows the virtually non-damaged single-crystalline zinc blende GaP lattice after the APS process. The preserved crystallinity of GaP in the fin structure is a clear indication of the atomic precision of the APS process.