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Enhanced electrical properties by post thermal nitridation in atomic-layer-deposited HfO_2 on InP YU-SEON KANG, DAE-KYOUNG KIM, HANG-KYU KANG, KWANG-SIK JEONG, MANN-HO CHO, DAE-HONG KO, Yonsei Univsersity, HYOUNGSUB KIM, Sungkyunkwan University, JUNG-HYE SEO, Korea Basic Science Institute, DONG-CHAN KIM, Samsung Electronics, SAMSUNG ELECTRONICS COLLABORATION, NEXT-GENERATION SUBSTRATE TECHNOLOGY FOR HIGH PERFORMANCE SEMICONDUCTOR DEVICES (NO. KI002083) COLLABORATION — We investigated the effects of post-nitridation in HfO_2 thin films grown on InP by atomic layer deposition on the structural, chemical, and electrical properties of the resultant film as well as its thermal stability compared to samples that were only thermally-annealed by comprehensive physical, electrical, and theoretical analyses. By post-deposition annealing under NH_3 vapor at 600°, an InN layer formed at the HfO_2/InP interface and ionized NH_x was incorporated in the HfO_2 film. Accordingly, interfacial reactions were effectively suppressed in nitrided HfO_2/InP by controlling out-diffusion of In or P atoms from the substrate. Nitridation of HfO_2/InP modulated energy band parameters at the HfO_2/InP interface, thereby decreasing leakage current. Moreover, the nitridation process significantly suppressed the generation of D_{it} due to controlled diffusion of In and P. DFT calculations showed that In_i and P_i in HfO_2 are closely related, with defect states within the band gap of InP.

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