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**Atomically flat Ge buffer layers and alternating shutter growth of $CaGe_2$ for large area germanane**[1] JINSONG XU, JYOTI KATOCH, ADAM AHMED, IGOR PINCHUK, ROBERT WILLIAMS, DAVID MCCOMB, ROLAND KAWAKAMI, Ohio State University — Germanane (GeH), which is converted from $CaGe_2$ by soaking in HCl acid, has recently attracted interest because of its novel properties, such as large band gap (1.56eV), spin orbit coupling and predictions of high mobility (18000 $cm^2/Vs$). Previously $CaGe_2$ was successfully grown on Ge(111) substrates by molecular beam epitaxy (MBE) growth. But there were cracks between m-sized islands, which is not desirable for scientific study and application, and limits the material quality. By growing atomically flat Ge buffer layers and using alternating shutter MBE growth, we are able to grow crack-free, large area films of $CaGe_2$ films. Reflection high energy electron diffraction (RHEED) patterns of Ge buffer layer and $CaGe_2$ indicates high quality two dimensional surfaces, which is further confirmed by atomic force microscopy (AFM), showing atomically flat and uniform Ge buffer layer and $CaGe_2$. The appearance of Laue oscillation in X-ray diffraction (XRD) and Kiessig fringes in X-ray reflectivity (XRR) proves the uniformity of $CaGe_2$ film and the smoothness of the interface. The high quality of $CaGe_2$ film makes it promising to explore novel properties of GeH.

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