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Epitaxial Co-Deposition Growth of $CaGe_2$ Films by Molecular Beam Epitaxy for Large Area Germanane PATRICK ODENTHAL, University of California Riverside, IGOR PINCHUK, ADAM AHMEN, The Ohio State University, WALID AMAMOU, University of California Riverside, JOSH GOLDBERGER, ROLAND KAWAKAMI, The Ohio State University — Here, we report the successful co-deposition growth of $CaGe_2$ films on Ge(111) substrates by molecular beam epitaxy and their subsequent conversion to germanane by immersion in hydrochloric acid. We find that the growth of $CaGe_2$ occurs within an adsorption-limited growth regime, which ensures stoichiometry of the film. We utilize *in situ* reflection high energy electron diffraction (RHEED) to explore the growth temperature window and find the best RHEED patterns at 750 °C. Finally, the $CaGe_2$ films are immersed in hydrochloric acid to convert the films to germanane. Auger electron spectroscopy of the resulting film indicates the removal of Ca and RHEED patterns indicate a single-crystal film with in-plane orientation dictated by the underlying Ge(111) substrate. X-ray diffraction and Raman spectroscopy indicate that the resulting films are indeed germanane. *Ex situ* atomic force microscopy shows that the grain size of the germanane is on the order of a few micrometers, being primarily limited by terraces induced by the miscut of the Ge substrate. Thus, optimization of the substrate could lead to the long-term goal of large area germanane films.

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