Epitaxial Growth of Binary Ferromagnetic Mn$_{3-\delta}$Ga Thin Films on Wurtzite GaN(0001) and Investigation by Atomic Scale Scanning Tunneling Microscopy E.D. LU, R. YANG, M.B. HAIDER, C. CONSTANTIN, A.R. SMITH, Condensed Matter and Surface Science Program, Department of Physics and Astronomy, Ohio University, Athens, OH 45701, J.W. KNEPPER, F.Y. YANG, Physics Department, Ohio State University, 191 Woodruff Avenue, Columbus, OH 43210 — Due to increasing interest in developing new magneto-optical and magneto-electronic devices, and spin injection sources in spintronics applications, ferromagnetic (FM) Mn$_{3-\delta}$Ga is an attractive candidate system to explore. Here we report that binary FM Mn$_{3-\delta}$Ga(1.14$<\delta<$2.0) single crystalline thin films has been epitaxially grown on (w)-GaN(0001)surfaces using molecular beam epitaxy. The face-centered tetragonal structure of Mn$_{3-\delta}$Ga thin films with CuAu-L$_{10}$ type ordering has been determined in situ by both reflection high energy electron diffraction and atomic-scale scanning tunneling microscopy. The epitaxial relationship of the Mn$_{3-\delta}$Ga with GaN(0001) is (111)[11\bar{2}]MnGa $\parallel$ (0001)[1\bar{1}0\bar{0}]GaN and (111)[1\bar{1}2]MnGa $\parallel$ (0001)[\bar{2}1\bar{0}]GaN. The hysteresis loops of the thin films show magnetic anisotropy along in-plane and out-of-plane directions. It is found that Curie temperature and magnetic moments of the Mn$_{3-\delta}$Ga thin films are closely related to the Mn content, and the reconstruction changes from 1x1 to 2x2 by increasing the ratio of Mn to Ga during the growth. Thus, we have achieved reconstruction-control of magnetic properties.

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