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High-quality $SrTiO_3$ films using a hybrid MBE approach BHARAT JALAN, ROMAN ENGEL-HERBERT, NICK WRIGHT, SUSANNE STEMMER, University of California Santa Barbara — A novel hybrid molecular beam epitaxy (MBE) approach for atomic-layer controlled growth of high-quality, epitaxial, stoichiometric $SrTiO_3$ films is presented. A solid source is used for Sr, an rf oxygen plasma source for oxygen and a metal-organic source for Ti. High-resolution x-ray diffraction revealed high quality single crystalline films with rocking curve full width half maxima similar to those of the substrates (i.e., 0.0095 $^\circ$ for a LSAT substrate). RHEED showed persistent layer-by-layer growth ($>$ 180 oscillations), which has previously been observed only in a very few other systems (Si and GaAs). Surface reconstructions were observed during growth and related to the growth modes. Depending on growth conditions, step flow growth was also observed. The film surface RMS roughness was less than 0.2 nm. Excellent film stoichiometry was confirmed by homoepitaxy (prefect overlap of film and substrate reflections). Films were very insulating, consistent with oxygen stoichiometry. Oxygen gettering Ti contacts and vacuum anneals were used to produce n-type, oxygen deficient films to study carrier mobilities. We demonstrate the relative influence of hydrogen and oxygen vacancies on the electrical conductivity of $SrTiO_3$.

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