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Origin of Metal-Insulator Transition at the $LaAlO_3/SrTiO_3$ interface induced by ion beam irradiation[1] ALEXEI KALABOUKHOV, TORD CLAESON, PIER PAOLO AURINO, Dept of Microtechnology and Nanoscience - MC2, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden, NIKOLINA TUZLA, LUNJIE ZENG, Dept of Applied Physics, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden, DAG WINKLER, Dept of Microtechnology and Nanoscience - MC2, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden, EVA OLSSON, Dept of Applied Physics, Chalmers University of Technology, SE-412 96 Gothenburg, Sweden — A quasi-two-dimensional electron gas appears when 4 or more unit cells of the $LaAlO_3$ film are deposited on a top of the TiO_2-terminated STO substrate. We show that it is possible to make the interface insulating using low-energy Ar+ ion-beam irradiation. The low energy Ar+ ions do neither etch the film below critical thickness nor create oxygen vacancies if the etching is terminated in time. The conductivity can be completely recovered by annealing under low oxygen pressure conditions. The restored interface shows strikingly similar electrical properties to the non-irradiated one and is also resistant to annealing at high oxygen pressure. High resolution transmission electron microscopy revealed that the difference between conducting and non-conducting interfaces is related to a change in stoichiometry of the LAO film where the La/Al ratio is 1.2 in the irradiated non-conducting areas while it is 1.0 in the conducting areas.

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