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BEEM and STS studies of aluminum oxide tunnel barrier layers P.G. MATHER, A.C. PERRELLA, J.C. READ, E. TAN, R.A. BUHRMAN[1] — The prevalence of AlO_x as the insulating layer in magnetic tunnel junctions and Josephson junction devices, including qubits, continues to motivate efforts to better control its electronic structure. While bulk Al_2O_3 has a band gap of $\sim$9 eV, amorphous AlO_x layers formed at 300K exhibit a much smaller band gap, as well as extensive band tails. We have used scanning tunneling spectroscopy (STS) to examine the density of states (DOS) at the oxide surface and ballistic electron emission microscopy (BEEM) to determine how these states couple through the oxide layer. We have compared the effect of thermal annealing on AlO_x layers to that of exposure to electron bombardment, both of which remove chemisorbed O_2^- from the surface of the AlO_x and drive the oxide to a more stoichiometric form. Both treatments increase the oxide band gap, however the electron bombardment has a less pronounced and different effect on the oxide states than 500 C anneals. The spread in the distribution of the DOS over an area of the oxide is reduced through both treatments, the greatest reduction taking place with the highest anneal temperature.

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