Electron Irradiation Induced Amorphous SiO$_2$ Formation at Metal Oxide / Si Interface at Room Temperature; Electron Beam Writing on Interfaces


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Al$_2$O$_3$ (5 nm) / Si (bulk) sample was subjected to irradiation of 5 keV electrons at room temperature, in a vacuum chamber (pressure $1 \times 10^{-9}$ mbar) and formation of amorphous SiO$_2$ (a:SiO$_2$) around the interface was observed. The oxygen for the silicon dioxide growth was provided by the electron bombardment induced bond breaking in Al$_2$O$_3$ and the subsequent production of neutral and/or charged oxygen. The a:SiO$_2$ rich layer has grown into the Al$_2$O$_3$ layer showing that oxygen as well as silicon transport occurred during irradiation at room temperature. We propose that both transports are mediated by local electric field and charged and/or uncharged defects created by the electron irradiation. The direct modification of metal oxide/silicon interface by electron-beam irradiation is a promising method of accomplishing direct write electron-beam lithography at buried interfaces. [1]