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MICROSTRUCTURES AND ATOMIC BEHAVIORS OF SEVERAL METAL ELECTRODE SYSTEMS ON SiO_2/Si ANNEALED IN O_2 AND N_2 AMBIENTS : Pt/(POLY-Si, TiN, AND Ti), Ru/POLY-Si, AND Ir/(POLY-Si AND TiN)

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Much concern to bottom electrode materials has given to applications of ferroelectric RAMs. In order to fabricate optimum capacitors, electrode materials should have several requirements such as low electrical resistivity, high thermal stability, good oxygen resistance and high etching rate. Several electrode systems which metals(Pt, Ru, and Ir) intervened by Ti, TiN, and poly-Si were deposited on SiO_2/Si. After annealing in O_2 and N_2 ambient at 400-700 ℃, behaviors of microstructural changes and atomic reactions between layers were investigated using various analytical techniques.

In the case of Pt/poly-Si, most Pt was changed to form PtSi at low temperature of 400 ℃. The Pt/TiN were relatively stable at 700 ℃ in contrast to the Pt/Ti system whose microstructures were underwent drastic changes above 500 ℃. TiN film was oxidized to form the ternary phase TiO_XN_Y. XRD results and AES depth profiles shown that Ru on poly-Si samples was splited to layers. The topmost RuO_2 was reacted with O_2. the middle remained pure Ru and the bottom formed Ru_2Si_3 layer. In this reaction, it is thought that the formation of Ru_2Si_3 was limited by blocking of both oxide layers. Ru samples have lots of protrusions, which is occurred due to the evaporation of ruthenium oxide RuO_4. Unlike Pt and Ru system, Ir systems were thermally stable without the any evidence of reactions with TiN and poly-Si. Only near surface was oxidized at 700 ℃ in O_2 ambient. Surface morphologies of Ir film were similar to those of Pt samples. Columnar shape of Ir grains was similar to those of Pt, Ru and RuO_2 of RuO_2/SiO_2 system that depends strongly on annealing temperature. When annealed in N_2, samples contained a little amount of nitrogen that is thought to be segregated at grain boundary.

From the above results, Ir metal electrode was thermally stable without silicidation and oxidation. Therefore Ir film directly contacted to poly-Si plug could be a promising electrode material for ferroelectric capacitors.