ABSTRACT

A conventional floating gate type nonvolatile semiconductor memory device had low charge retention characteristic. In order to improve this, the thickness of the tunnel insulating film and the thickness of the gate oxide film were increased sufficiently. As a result, however, there caused difficult problems in obtaining a fast operation speed and a highly dense memory capacity.

In order to solve the above-mentioned problems the nonvolatile semiconductor memory device of the present invention employs for the floating gate for retaining electric charges, a material having a high work function or a high electron affinity, or a material having a small difference of work function with respect to the semiconductor substrate or the control gate, and for the insulating matrix, an amorphous material having a small electron affinity. Further, the proportion of the material for nano-particles to the material for the insulating matrix to be supplied when the charge retention layer is formed, e.g., the mixture ratio of the materials constituting two phases as targets in a sputtering method is adjusted, and the space distance between the outer shells of adjacent nano-particles is optimized, whereby the charge retention characteristic of the floating gate type nonvolatile semiconductor memory device under circumstance of the room temperature or an elevated temperature can be improved; the rewriting

performance and multi-value memorizing operations can be stabilized, and the above-mentioned problems on the conventional nonvolatile semiconductor memory device can be solved.