

ABSTRACT OF THE DISCLOSURE

A method of manufacturing a semiconductor device includes forming a preliminary lower electrode layer on a substrate, the preliminary lower electrode layer including a niobium oxide; converting at least a portion of the preliminary lower electrode layer to a first lower electrode layer comprising a niobium nitride by performing a nitridation process on the preliminary lower electrode layer; forming a dielectric layer on the first lower electrode layer; and forming an upper electrode on the dielectric layer.

FIG. 2