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[54] **METHOD OF ETCHING TITANIUM DIBORIDE**

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[52] **U.S. Cl.** **156/643**

[58] **Field of Search** 156/643, 646, 664, 656, 156/659.1, 904

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[57] **ABSTRACT**

A thin film of titanium diboride that has been deposited onto a substrate and patterned using photolithography is dry etched in a commercial plasma etcher with either a chloride, or a mixture of a chloride gas with oxygen, or a mixture of a chloride gas with nitrogen, or a mixture of a chloride gas with a noble gas, or a fluoride gas, or a mixture of a fluoride gas with oxygen, or a mixture of a fluoride gas with nitrogen, or a mixture of a fluoride gas with a noble gas.

11 Claims, No Drawings

METHOD OF ETCHING TITANIUM DIBORIDE

This invention relates in general to a method of etching titanium diboride and in particular to a method of dry etching a thin film of titanium diboride that has been deposited onto a substrate and patterned using photolithography.

BACKGROUND OF THE INVENTION

Titanium diboride has become of interest in laboratory research because of its resistance to change or degradation at high temperatures. It also shows promise in acting as a diffusion barrier to other metals.

One of the difficulties involved with working with titanium diboride is that because of its resistance to attack, it is difficult to pattern. In fact, no wet etches have been available to carry out such patterning.

SUMMARY OF THE INVENTION

The general object of this invention is to provide a method of etching titanium diboride. A more particular object of this invention is to provide a method of etching a thin film of titanium diboride that has been deposited onto a substrate and patterned using photolithography.

It has now been found that the aforementioned objects can be attained by etching titanium diboride with a dry etch.

More particularly, according to the invention, a thin film of titanium diboride that has been deposited onto a substrate and patterned using photolithography is dry etched by first mounting the substrate bearing the patterned thin film on the lower electrode of pair of electrodes in the etch chamber of a commercial plasma etcher or plasma therm etcher. The etch chamber is evacuated to a pressure of about 10^{-6} Torr and a dry etchant as, for example, dichlorodifluoromethane (CCl_2F_2) admitted at a flow rate of about 1 to 100 sccm and a pressure set at about 1 to 500 mTorr. An electric field is applied between the electrodes, the power level set at about 50 to 1000 watts and etching allowed to proceed for the desired time.

Other dry etchants that will etch TiB_2 include a chloride gas, a mixture of a chloride gas with oxygen, a mixture of a chloride gas with nitrogen, a mixture of a chloride gas with a noble gas, a fluoride gas, a mixture of a fluoride gas with nitrogen, a mixture of a fluoride gas with oxygen, and a mixture of a fluoride gas with a noble gas.

After the dry etch, the sample is removed and the etch rate determined by measuring the etch depth and dividing by the etch time.

By adjusting the process parameters, one is able to attain etch rates of 5 to 800 Å/min for TiB_2. This is useful for patterning TiB_2 as a diffusion barrier or a Schottky contact to semiconductors.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A thin film of TiB_2 is first deposited on a gallium arsenide substrate by e-beam evaporation and the substrate with thin film of TiB_2 then patterned using photolithography.

The substrate bearing the patterned film is then mounted on the lower electrode of a pair of electrodes in the etch chamber of a commercial plasma etcher. The etch chamber with the electrodes inside is then evacuated to a pressure of about 10^{-6} Torr. CCl_2F_2 is then admitted into the etch chamber at a flow rate of about 2 to 40 sccm and the pressure set at 10 to 200 mTorr. An electric field is applied between the electrodes and the power level set at 150 to 400 watts. The etch is allowed to proceed until the TiB_2 is completely removed in the areas exposed by the photolithography.

Other dry etch processes that can be used to etch TiB_2 include reactive ion beam etching (RIBE), chemically assisted ion beam etching (CAIBE), reactive ion etching (RIE), and magetron ion etching (MIE).

I wish it to be understood that I do not desire to be limited to the exact details as described for obvious modifications will occur to a person skilled in the art.

What is claimed is:

1. Method of etching a thin film of titanium diboride that has been deposited onto a substrate and patterned using photolithography, said method including the steps of:

(A) mounting a substrate bearing a patterned thin film of titanium diboride on a lower electrode of a pair of electrodes in an etch chamber of a plasma therm etcher,

(B) evacuating the etch chamber to a pressure of about 10^{-6} Torr,

(C) admitting a dry etchant to the etch chamber at a flow rate of about 1 to 100 sccm and a pressure set at about 1 to 500 mTorr,

(D) applying an electric field between the pair or electrodes and setting the power level at about 50 to 1000 watts, and

(E) allowing the etch to proceed for a preselected time.

2. Method according to claim **1** wherein the dry etchant is selected from the group consisting of a chloride gas, a mixture of a chloride gas with oxygen, a mixture of chloride gas with nitrogen, a mixture of a chloride gas with noble gas, a fluoride gas, a mixture of a fluoride gas with oxygen, a mixture of a fluoride gas with nitrogen, and a mixture of a fluoride gas with a noble gas.

3. Method according to claim **2** wherein the dry etchant is a chloride gas.

4. Method according to claim **3** wherein the dry etchant is dichlorodifluoromethane.

5. Method according to claim **2** wherein the dry etchant is a mixture of chloride gas with oxygen.

6. Method according to claim **2** wherein the dry etchant is a mixture of chloride gas with nitrogen.

7. Method according to claim **2** wherein the dry etchant is a mixture of a chloride gas with a noble gas.

8. Method according to claim **2** wherein the dry etchant is a fluoride gas.

9. Method according to claim **2** wherein the dry etchant is a mixture of a fluoride gas with oxygen.

10. Method according to claim **2** wherein the dry etchant is a mixture of a fluoride gas with nitrogen.

11. Method according to claim **2** wherein the dry etchant is a mixture of a fluoride gas with a noble gas.

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