Product Bulletin 320

Etch Stop Application for BoronPlus Sources

Introduction

Sensors and miniature devices made from silicon wafers have been the subject of intense research by many companies and certain universities during the last several years. Thin membranes for pressure sensors, cantilever beams for acceleration sensors, bridges for measuring fluid flow rates, small holes for sieves, various parts for miniature motors, etc. are already being fabricated for assembling into devices for a number of industrial applications [1-15].

By utilizing standard silicon processing techniques, areas of high boron concentration can be carefully located within the silicon wafer by diffusion. These areas act as "etch stops" for different silicon etchants [16,17] and are critical to successfully etching thin membranes and various micromechanical parts from the silicon wafer.

Many researchers have used BoronPlus dopant sources to dope the silicon with boron to create the etch stop for the silicon etchants [18-22]. The BoronPlus sources are a highly desirable source for boron because they are safe and easy to use, and because they provide sufficient boron to create the desired etch stop in the silicon wafers. The sources can also be used in the presence of oxygen permitting the boron silicon phase that forms on the surface of the silicon wafer to be oxidized while cooling in oxygen from the deposition temperature (in-situ LTO). This bulletin summarizes some of the procedures that have been developed over the years for using BoronPlus sources in the etch stop application.

Typical Deposition Cycle

Table 1 outlines a typical deposition cycle for an etch stop diffusion. Several of the basic parameters that must be taken into consideration when designing one of these processes are:

1. Deposition Temperature and Time

The deposition temperature usually ranges between 1100° and 1200°C for the following reasons:

a) The boron in the silicon must be greater than about 1E20 atoms/cc to stop the anisotropic etchants, and

b) The boron concentration of 1E20 must be maintained from the surface to several microns below the silicon surface.

The high deposition temperature results in the formation of the desired boron concentration in the silicon wafer, and it causes the deposited boron to diffuse into the silicon wafer from its surface at a relatively high rate.

Figure 1 shows the relationship between the depth where the boron concentration is about 1E20 (etch stop layer) [21,23] and the diffusion time at various temperatures to reach this depth. Although these data can be used to quite accurately predict the thickness of large-area diffused membranes, other factors can have significant effects upon the shape and dimensions of certain intricate substrates being etched from silicon [8,17,24]. These factors include the lateral diffusion of boron in silicon, the thickness of the desired substrate, and the dimensions of the diffusion window in the field oxide.

If the silicon sensor is to contain an active device area, the area on the silicon wafer must be defined before the etch stop diffusion is performed. Procedures to isolate these active areas and to incorporate MOS devices on them have been developed and have been successfully used to make devices [8].

Table 1. Typical Etch Stop Diffusion Cycle

Source Type:	Source Size:	Source

Figure 1
Etch Stop Diffusions From BoronPlus Sources [21, 23]

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For more information on this Product Bulletin or on the BoronPlus dopant sources, contact the Planar Dopants Team: www.techneglas.com

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