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Investigations on a Multiple Mask Technique to Depress Processing-Induced Damage of ICP-Etched HgCdTe Trenches

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A multiple mask technique, integrating patterned silicon dioxide (SiO_2) film over patterned thick photoresist (PR) film, has been investigated as a method to perform mesa etching for device delineation and electrical isolation of mercury cadmium telluride (HgCdTe) third-generation infrared focal-plane arrays. The multiple mask technique was achieved by standard thick PR photolithography, SiO_2 film deposition to cover the thick PR patterned film, and etching the SiO_2 film at the bottom region after another photolithography process. The dynamic resistance in the zero-bias and low-reverse-bias regions of HgCdTe photodiode arrays isolated by inductively coupled plasma (ICP) etching with the multiple mask of patterned SiO_2 and patterned thick PR film underneath was improved one- to twofold compared with a simple mask of patterned SiO_2. It is suggested that the multiple mask technique is capable of maintaining high etching selectivity while reducing the side-wall processing-induced damage of ICP-etched HgCdTe trenches. The results show that the multiple mask technique is readily available and shows great promise for etching HgCdTe mesa arrays.

Key words: Mercury cadmium telluride (HgCdTe), inductively coupled plasma (ICP), processing-induced side-wall damage, high etching selectivity

INTRODUCTION

High-aspect-ratio trenches or holes are essential to realize high-performance $Hg_{1-x}Cd_xTe$ (mercury cadmium telluride) infrared (IR) detectors, and dry etching by CH_4-H_2-based plasma has been widely explored for this kind of application.[1,2] Several research groups have reported progress on high-density "dry" electron cyclotron resonance (ECR) plasma or inductively coupled plasma (ICP)-enhanced reactive-ion etching (RIE) technologies for HgCdTe device fabrication.[3,4] In most of the reported studies and device fabrications, patterned thick photoresist (PR) film as a mask to etch HgCdTe material are formed using a standard photolithography process.

Recently, a single mask of patterned silicon dioxide (SiO_2) film had been implemented in our laboratory to improve the smoothness and cleanliness of the HgCdTe ICP-etched surface, and also to increase the etching selectivity between HgCdTe and the mask film.[5] However, we found that the *p*–*n* junction performance of ICP-etched HgCdTe photodiodes was worse with SiO_2 masks compared with simple thick PR masks with low etch selectivity. It was deduced that the processing-induced side-wall damage of ICP-etched trenches was increased when the simple mask was changed from the patterned thick PR film to the patterned thin SiO_2.

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