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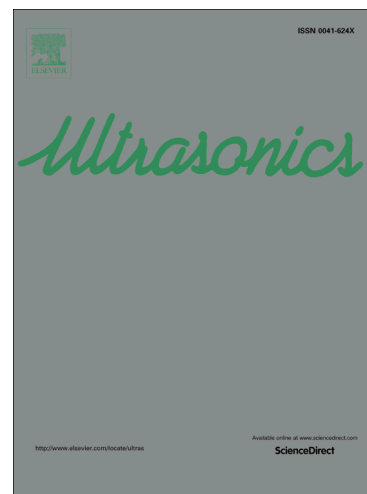
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Study on chemical mechanical polishing of silicon wafer with megasonic vibration assisted

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Abstract

Chemical mechanical polishing (CMP) is the primary method to realize the global planarization of silicon wafer. In order to improve this process, a novel method which combined megasonic vibration to assist chemical mechanical polishing (MA-CMP) is developed in this paper. A matching layer structure of polishing head was calculated and designed. Silicon wafers are polished by megasonic assisted chemical mechanical polishing and traditional chemical mechanical polishing respectively, both coarse polishing and precision polishing experiments were carried out. With the use of megasonic vibration, the surface roughness values Ra reduced from 22.260nm to 17.835nm in coarse polishing, and the material removal rate increased by approximately 15-25% for megasonic assisted chemical mechanical polishing relative to traditional chemical mechanical polishing. Average Surface roughness values Ra reduced from 0.509nm to 0.387nm in precision polishing. The results show that megasonic assisted chemical mechanical polishing is a feasible method to improve polishing efficiency and surface quality. The material removal and finishing mechanisms of megasonic vibration assisted polishing are investigated too.

Keywords: Chemical mechanical polishing, Megasonic vibration, Silicon wafer, Matching layer, Surface quality.

1. Introduction

Silicon wafer is the basic material in integrate circuit industry and widely used in semiconductor device. Chemical mechanical polishing (CMP) is considered to be the primary method to realize the global planarization of silicon wafer [1]. In this physicochemical process, the slurry and silicon wafer produce chemical reaction and form a soft layer on the surface, abrasive particles in the slurry and polishing pad repeated grinding, rolling, or sliding against the surface of the silicon wafer. These two processes combine to achieve both a high surface quality of silicon wafer while maintaining a high material removal rate [2,3]. With the increase of size of silicon wafer and the shrink of feature size on the IC chip, CMP process faces new challenges [4,5].

As we know, ultrasonic wave assisted chemical mechanical polishing have effect on improving polishing efficiency and surface quality [6,7]. But, as a key element, ultrasonic transducer used for chemical mechanical polishing has some common problems in structure and vibration transmission. Ultrasonic vibrator have to meet the intrinsic vibration mode of the polishing tool head [7], so it is difficult to achieve a large-scale ultrasonic

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