Membrane Embedded Polisher Head의 Plate 구조의 영향

조경수, 이양원, 김대영, 이진규, 김활표, 정제덕, 하현우, 정호석, 양원식
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The Influence of Plate Structure in Membrane Embedded Head Polisher

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Abstract

The requirement of planarity, such as with-in-wafer nonuniformity, post thickness range, have become increasingly stringent as critical dimensions of devices are decreased and a better control of a planarity become important. The key factors influencing the planarity capability of the CMP process have been well understood through numerous related experiments. These usually include parameters such as process pressures, relative velocities, slurry temperature, polishing pad materials and polishing head structure.

Many study have been done about polishing pad and its groove structure because it's considered as one of the key factors which can decide wafer uniformity directly. But, not many study have been done about polisher head structure, especially about polisher head plate design.

The purpose of this paper is to know how the plate structure can affect wafer uniformity and how to deteriorate wafer yield. Furthermore, we studied several new designed plate to improve wafer unifoprmity and also improve wafer yield.

Key Word : Annual Rinf Fail, Membrane, Plate Structure, Head, Polisher

1. 서 론

Recently, DAS(Dong-Bu ANAM Semiconductor) has found that some strange failure can be happened when MIRRA CMP system was used in intermetal Oxide CMP. The shape of Yield Map of this failure is very similar with the shape of annual ring as you see in fig.1. So, we called this as annual ring failure.(ARF).

ARF(Annual Ring Failure) can be found just in AMAT MIRRA CMP system,

not EBARA and 472 system. And, also it can be found in a condition of

multiple wafer cummap of which nember of die is more than 1000.

A lot of study have been done to know the root cause of this failure,

especially about structure of head plate and groove type of polishing pad.

After all, we found that hole position of the plate can cause wafer topology in same area, and finally can affect wafer yield in that area. Figure 2 shows the mechanism of Annual ring failure.

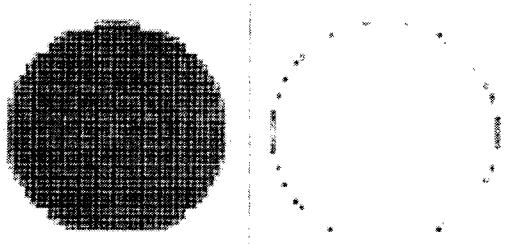

Fig. 1. The shape of Yield failure map(right side) is very similar with the shape of annual ring.

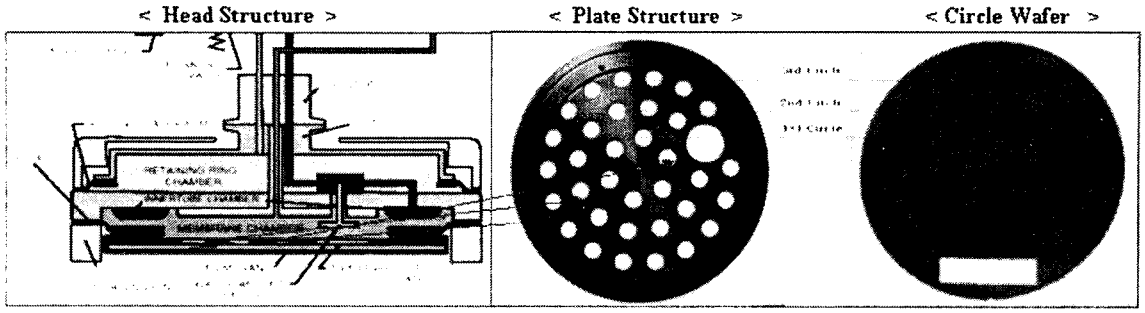

Fig. 2. Structure of Mirra CMP Head and its Plate. It can cause wafer topology just like annual ring.

2. 실 험

A standard Mirra CMP System with 34 standard plate hole of polishing head and K-Groove polishing pad with Wide Deep Groove was used with commercial consumables. ; A standard membrane, retainer ring, diamond disk, and slurry. Newly designed plate of which hole size and arrray is different with standard, was used in this test. We also did analysis to verify how differently it works in the different conditions.

For polishing performance characterization, p-TEOS deposited wafers were polished for 3 min followed by 40 sec DHF clean. Thickness of p-TEOS before and after polish was measured in the radial direction using an optical thickness measurement tool to obtain the post thickness profile with an edge exclusion of 3 mm. Line scan profile with an 100 point was also studied.

3. 결과 및 고찰

Effect of Groove of polishing pad

To verify whether the ARF is from the groove of pad or not, we did test with different type of pad.

Result shows that Perforate grooveis much better than K-groove in terms of topography. But, Annual ring Shape cannot be removed at all.

Regardless of groove type, annual ring happened in exactly same position in wafer surface.

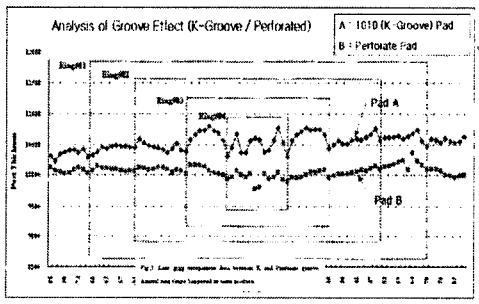

Fig. 3. Line scan comparison data between K and Perforate groove. Annual ring shape happened in same position.

Effect of New Plate (Different hole size & Array)

To verify whether the hole of the plate can affect the shape of wafer topography or not, we tried to change the array and the size of the hole. Figure 4 shows the example of newly designed plate.

16 hole type is to minimize the hole effect to wafer topography.

Random 31 hole is to avoid the Ring-shape in the wafer. We expected that Pressure will be applied differently on the wafer compared to standard plate.

Mixed hole type is the plate which has different hole size and array together in one plate.

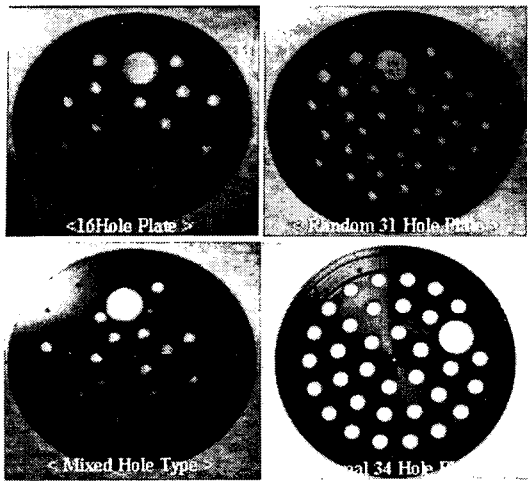

Fig. 4. Various type of plate design. Each plate has different hole size and array ; 16 hole, 31 hole, mixed and standard 34 hole.

During the brain-storming, we expected that Mixed hole type will be the best condition.
But, we cannot do a test with this because it cannot pick-up the wafer well. We guess it is because of the pressure and vacuum unbalance Figure 5 and 6 is the test result of each plate.

In terms of non-uniformity, result of 31 and 16 hole is slightly better than baseline condition. But, during the test period, we cannot find out annual ring shape in the new plate condition ,otherwise many annual ring shape of wafer found in baseline condition.

we could come to a conclusion that annual ring failure can be overcome through use of new plate. 31 hole is slightly better than 16 hole in te4rms of non-uniformity.(Fig.6.)

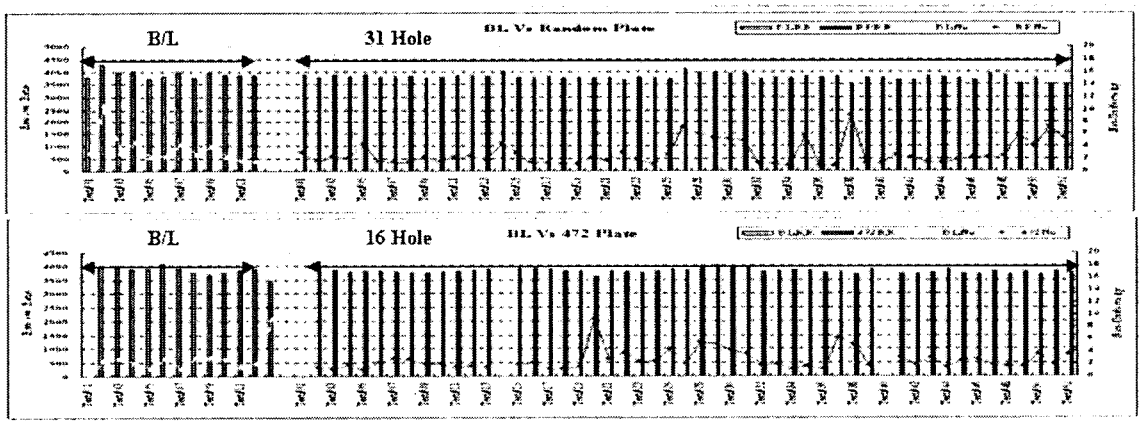

Fig. 5. Performance Comparison of Each Plate(Standard vs 31Hole , Standard vs 16 Hole).

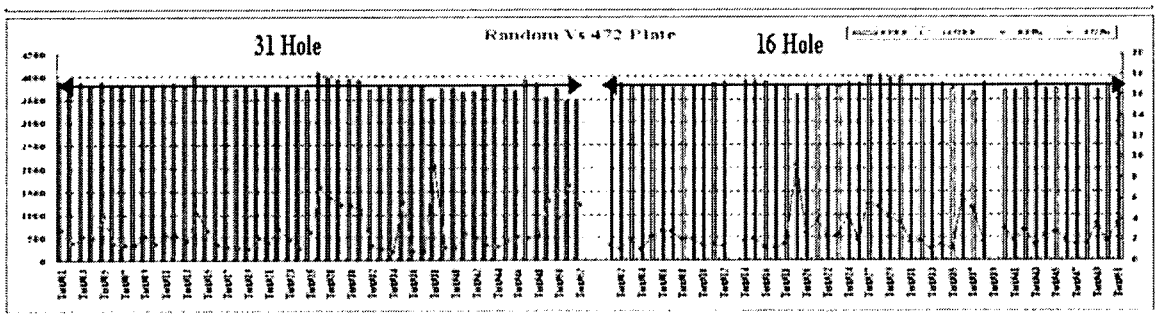

Fig. 6. Performance Comparison of Each Plate (31Hole vs 16 Hole).

4. 결 론

It has been shown that Annual ring Failure can be happened when the Mirra CMP system used in inter-metal Oxide CMP. We cannot find these kind failure any other system. The main reason of this shape is from the plate structure, so we prepared several new plate. Though no annual ring shape found in new plate during the test, very few ring shape of wafer found in new plate in long term period test. We guess it's from rotation motion of head itself of CMP system. Even though thickness variation of its topography is very trivial, we are trying to remove it through recipe modification. Further study will be reported soon.

감사의 글

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