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Post-CMP Defect Management in Advanced Node DRAM Development

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The introduction of new materials, slurries, and process conditions in chemical mechanical polishing (CMP) has induced new types of defects in semiconductor processing. Many different types of defects such as brush mark, pad residue, shallow scratches are emerged as major concern in advanced technology node, since the defects have more impact on the yield due to the shrinkage of the critical dimension whereas the choice of post CMP cleaning condition has more limitations due to the sensitivity of the structures and materials to the chemicals.

In this presentation, various types of post CMP defects during development of advanced DRAM technology node will be discussed. The first case is brush mark on poly silicon surface after poly Si CMP, as shown in Fig. 1. This has generated noisy defect pattern at the following inspection steps. The root cause of the issue has been identified as hydrophobicity of the poly surface after HF cleaning, which has required optimization of brush cleaning condition to solve the problem.

Another type of defect is macro-scale defects after metal plug CMP. Several arc-type scratches were identified after the CMP process across the wafer as shown in Fig. 2(a). The source of the scratches were suspected as the fixed small residues on the pad surface, since the arcs are well matched with expected trajectory of a single point scratch source on the pad. Figure 2(b) shows circular pattern of defect, which might be due to fixed particle source on the brush. These defects were cleared by tuning conditioning and brush process conditions. Few more cases of new defects and details of the optimization will be discussed further.

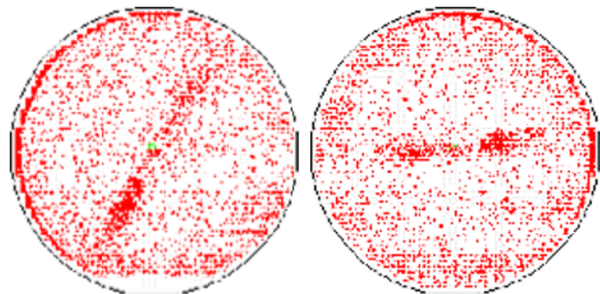

Fig.1 Wafer inspection images with brush mark after poly CMP

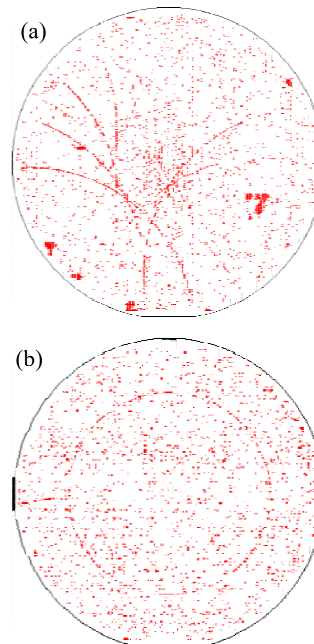

Fig. 2 Wafer inspection images with (a) arc-type defect pattern, (b) ring-type defect pattern after metal plug CMP

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