Evaluation of Metal Etches on Unpatterned Wafers Using Surface Haze Measurements

B. Donehoo and S. Biswas

Portland Technology Development, Intel Corp., Hillsboro, OR USA 97124

ABSTRACT

Laser light scattering is an extremely useful metrology tool for detecting process defects with both high sensitivity and high wafer throughput on unpatterned wafers[1]. In addition to capturing the higher spatial frequency components (i.e. defects), the low spatial frequency background scatter signal (i.e. haze) can also be leveraged for better yield learning about new processes. This background haze signal is sensitive to local changes in surface reflectance and roughness, thereby making haze useful for characterizing film properties such as composition, morphology or thickness over the entire wafer surface[2].

Here we describe a series of experiments aimed at optimizing a metal etch process on unpatterned wafers across a skew of process parameters. During the course of the investigation it was found that though the defect signal could discern some information about the etch residue removal efficiency, it could not be used to conclusively distinguish between non/partial/total etches of the metal. In contrast, by using surface haze data we were able to show a very clear distinction between the various wafer states, even when the defect signal was itself ambiguous (see Figure 1 below). Thus accurate and rapid characterization of etch skews was achieved by utilizing the surface haze signal (both within wafer and wafer-to-wafer) as a metric for etch quality, leading to an efficient optimization of the etch process in question.

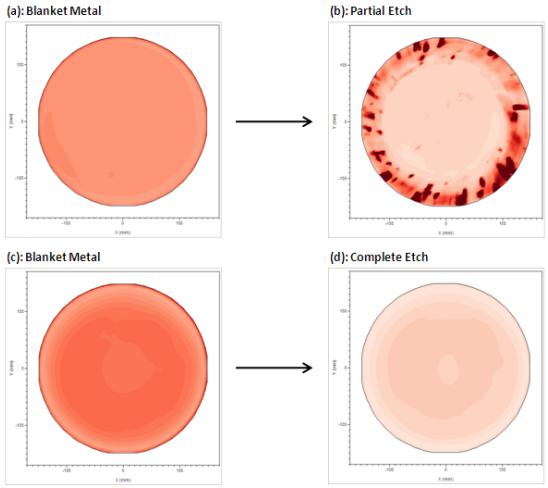

FIGURE 1. Example of (a-b) partial etch and (c-d) full etch surface haze maps showing high contrast on remaining residues. Areas of red correspond to regions of higher surface haze compared to the white regions.

REFERENCES

1. Okamoto, A.; Kuniyasu, H.; Hattori, T., *Semiconductor Manufacturing, IEEE Transactions on* , vol.19, no.4, pp.372-380, Nov. 2006
2. Halder, S.; Vos, R.; Masayuki, W.; Kenis, K.; Bearda, T.; Radovanovic, S.; Dighe, P.; Leunissen, L.H.A.; Mertens, P.W., *Semiconductor Manufacturing, IEEE Transactions on* , vol.22, no.4, pp.587-591, Nov. 2009

Keywords: Surface Haze, Scattering, Etch