Motivation

1. Galvanic corrosion: accelerated corrosion of a metal placed in electrical contact with more noble metal in an electrolytic solution; characterized by the localized corrosion of the metal at the two-phase boundary, and remarkable accelerated corrosion if the area of the reactive metal is small compared to that of the more noble metal.

2. Damsasene copper wafers contain potential galvanic couples in CMP solutions. Galvanic corrosion of either copper or the barrier material may impair the quality and reliability of copper interconnects. This effect will become increasingly pronounced with smaller-scale features.

3. Galvanic corrosion processes are electrochemical in nature and can be studied using electrochemical techniques. The distribution of electrolyte on the surface may be affected by the wetting behavior of surfaces, and influence the extent and distribution of the corrosion damage.

2005 Main Objectives

Year 1:
- Studies on the polarity of Cu-Ta couple in CMP slurries and the sensitivity to solution chemistry.
- Determine the more reactive material in Cu-Ta couple in specific solutions, and effects of solution chemistry on the polarity of the bimetal couple.

Year 2:
- Further studies on galvanic corrosion of Ta-Cu couple.
- Develop different methodologies for galvanic corrosion testing: directly assess the galvanic current at steady-state and measure its distribution, and correlate the distribution of corrosion products with the presence of a potential difference.
- Wetting studies on multi-phase surfaces (MT, in progress).
- Study the wetting behavior of Cu, Ta, and their derivatives in solutions containing any type of surfactant or other solvents.

Year 3:
- Develop experimental setup capable of both electrochemical measurements and mechanical testing.
- Develop different methodologies for galvanic corrosion testing: directly assess the galvanic corrosion rate (in the form of current) as well as the polarity of the galvanic couple (MT, modified).
- Consider the effect of mechanical action on galvanic current and the polarity of the galvanic couple (MT, modified).

Experimental Study

Experimental setup and samples

Results of electrochemical measurements

- Area ratio effect, without polishing
- Effects of [P(02)], pH, without polishing

Contact angle measurement

- The contact angles as function of solution chemistry on Ta/TaN, Cu and dielectric material (TEOS or SiO2) will be explored.

Future Goals

- Further studies on modification of the wetting behavior through optimized use of surfactants and other solvents.
- Develop chemical models to characterize the material removal due to chemical/electrochemical effects, and integrate the chemical models into the comprehensive CMP model to account for mechanical, interfacial and chemical phenomena (Year 3 Milestone for CMP group).

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