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Chemical vapor deposition of copper for advanced IC metallization

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Metallization in advanced integrated circuit(IC) devices are becoming important with increasing device density and decreasing feature sizes because the performance of the total system is dominated by the interconnections. Copper is a promising interconnection metal for the ultra large scale integration(ULSI) era due to the its low resistivity, low electromigration, and high melting temperature compared with aluminum and aluminum alloys, even though there are a few problems of copper technology. The process reliability concerns related to the increased limitation of presently used sputtering process make CVD(chemical vapor deposition) a leading contender for use as a metallization process in sub half micron era. CVD gives an excellent conformal coverage over rough surface and complete via filling ability.

Copper CVD has been widely investigated with an emphasis on developing new precursors to abtain low deposition temperatures, high film growth rates, and selectivity. Precursors for copper CVD are available from both copper(I) and copper(II) derivatives. Copper(II) complexes are often require high temperatures for deposition and hydrogen is needed for pure copper deposition. Compared with copper (I) precursors, recently proposed copper(I) compounds usually have low decomposition temperatures and hydrogen usually is not required because the deposition reaction of copper(I) precursors is a thermally induced disproportionation. However, copper(II) precursors are said to be more thermally and structurally robust. Cu(HFA)(TMVS) and $Cu(HFA)_2$ have attracted the most interest due to clean decomposition, high volartility, and selectivity among the each copper(I) and copper(II) precursors.

In this paper, the emerging issues and the results of copper CVD, including possible reaction mechanisms, film growth kinetics, and the characteristics of CVD copper films, will be discussed.