CHEMICAL VAPOR DEPOSITION OF NOVEL PRECURSORS FOR ADVANCED CAPACITOR ELECTRODES

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The continued scaling of semiconductor devices to below the 100 nm technology node places significant challenges on the development of novel chemical vapor deposition (CVD) precursors to enable continued performance gains. In particular, both DRAM cell capacitor and the transistor gate stack represent technologies wherein new material systems and integration strategies are needed. In both cases, polysilicon is used as the electrode material. However, the poor stability of polysilicon in contact with key high dielectric constant metal oxides, as well as depletion effects in transistor gate stacks, is driving a critical need for the development of robust, thermally stable, and highly conductive electrode materials. Platinum group metals are under consideration as electrode materials owing to their refractory nature, low electrical resistivity, and work functions that are appropriate for CMOS transistor applications. In addition to materials issues, the processing of such layers becomes increasingly problematic with continued device scaling. The increased susceptibility to plasma induced physical and electrical damage in transistors with ultra thin gate dielectrics, as well as the increased geometrical complexity of advanced DRAM cell capacitor structures, requires the development of chemical vapor deposition (CVD)–based techniques for the processing of these layers. However, key in the development of such processes is the availability of precursors with adequate vapor pressures and suitable decomposition pathways. Figure 1. describes the methodology for the developing and incorporating new CVD precursors. Rapid synthesis and screening are critical to the successful incorporation of new CVD precursors. The work presented herein will discuss the development of CVD processes using novel candidate ruthenium chemistries for the growth of high purity Ru and RuO_2 thin films (see Figure 2.) for both DRAM electrode and CMOS gate electrode applications. In addition to precursor properties such as vapor pressure and decomposition behavior, relevant thin film performance data will also be discussed. In particular, film purity, crystallographic and microstructural properties, and thermal stability will be discussed, as well as the film's electrical properties.

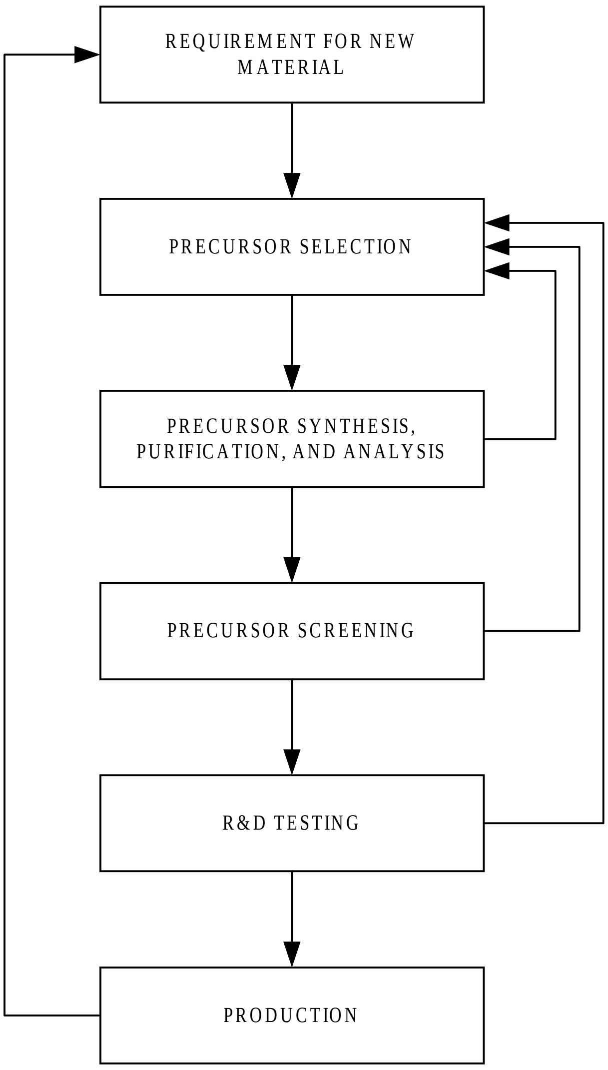

Figure 1. Methodology for incorporation of new CVD precursors.

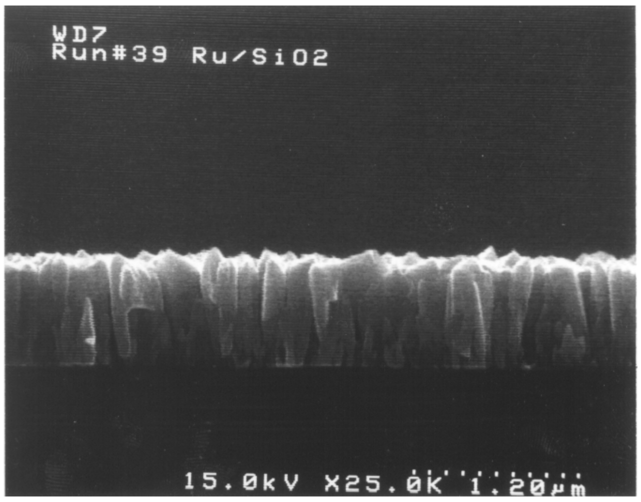

Figure 2. Ruthenium oxide thin film deposited on SiO_2 by CVD.