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Selective Deposition of Ruthenium Films by Digital Chemical Vapor Deposition

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Patent pending

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Background

Recently, efforts have been made to obtain larger capacitance values in capacitors of semiconductor devices using noble metals such as ruthenium (Ru), platinum (Pt), iridium (Ir), and osmium (Os) as a lower electrode or an upper electrode of a capacitor. Chemical vapor deposition (CVD) is often used to deposit this metal over the entire wafer surface. In later steps, the undesired portions of the metal thin film are removed by etching and cleaning, leaving the metal thin film in the desired locations. However, the etching process to remove the undesired metal thin film adds manufacturing costs and increases the chance of etch-induced damage.

Invention Description

Researchers at Arizona State University have developed a manufacturable selective CVD process for Ru deposition which eliminates the post-CVD etching step to remove excess material. Ru is deposited on the wafers using a Liquid Source Metal-Organic Chemical Vapor Deposition (LS-MOCVD) technique. Experimental results revealed the deposition of dense and polycrystalline films of Ru.

Among the noble metals, ruthenium has excellent leakage current characteristics and easier processing characteristics. This process eliminates the need for etching and hence its associated cost and potential for etch-induced damage.

Potential Applications

- Metallization in advanced semiconductor devices
- Contact electrodes and temperature barriers in Random Access Memories
- Thin film deposition in microelectronic applications, VLSI and ULSI devices

Benefits and Advantages

- Highly selective and conformal deposition of Ru
- Offers excellent mechanical and chemical properties
- Eliminates etching process and the damages caused by etching
- Reduced cost of metallization in electronic devices
- Accurate control of thickness and composition of the film