Atomic Layer Deposition of Ruthenium with TiN Interface for Sub-10 nm Advanced Interconnects beyond Copper - DTU Orbit (01/08/2018)

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Atomic layer deposition of ruthenium is studied as a barrierless metallization solution for future sub-10 nm interconnect technology nodes. We demonstrate the void-free filling in sub-10 nm wide single damascene lines using an ALD process in combination with 2.5 angstrom of ALD TiN interface and postdeposition annealing. At such small dimensions, the ruthenium effective resistance depends less on the scaling than that of Cu/barrier systems. Ruthenium effective resistance potentially crosses the Cu curve at 14 and 10 nm according to the semiempirical interconnect resistance model for advanced technology nodes. These extremely scaled ruthenium lines show excellent electromigration behavior. Time-dependent dielectric breakdown measurements reveal negligible ruthenium ion drift into low-kappa dielectrics up to 200 degrees C, demonstrating that ruthenium can be used as a barrierless metallization in interconnects. These results indicate that ruthenium is highly promising as a replacement to Cu as the metallization solution for future technology nodes.

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