

# A future CMOS gate stack: Mining the periodic table

David Gilmer\*

*Motorola, 3501 Ed Bluestein Blvd., MD-K10, Austin, TX, 78721, USA.*

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Near future deep sub-micron device scaling now requires gate dielectrics to be thinned to much less than 1.5 nanometers. However, the currently used materials of poly-silicon gate electrodes and silicon dioxide or oxynitride gate dielectrics can not deliver the desired device performance for this scaled gate-dielectric thickness. To address this problem, metal-gate electrodes to eliminate poly-silicon depletion effects, in conjunction with high dielectric constant (high-K) metal-oxide insulators to allow for continued electrical thickness scaling with a physically thicker gate dielectric, are being extensively studied throughout the industry for use in ultra-scaled metal-oxide-semiconductor field-effect transistor (MOSFET) devices. A key to finding high-K metal-oxide gate dielectric and metal gate electrode materials that are compatible with each other, can tolerate the required device fabrication process, and yield the desired MOSFET properties, is far from trivial. Here we report on results related to searching the periodic table to find metal gate and metal-oxide high-K gate dielectrics for integration into capacitors and MOSFET devices.

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\* Corresponding author. Tel. 512-933-8762. FAX 512-933-6962.  
*Email address:* [David.Gilmer@motorola.com](mailto:David.Gilmer@motorola.com) (David Gilmer).