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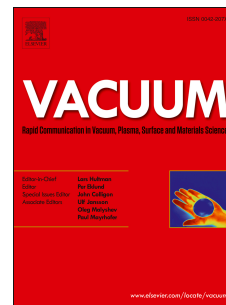
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# Effects of Thermal Annealing on the Interface between Tungsten and CeO<sub>2</sub>/La<sub>2</sub>O<sub>3</sub> Stack Gate Dielectrics

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## Abstract

The impacts of thermal annealing on the interfacial reactions and bonding structures between the tungsten metal gate and CeO<sub>2</sub>/La<sub>2</sub>O<sub>3</sub> stacked dielectrics were investigated by x-ray photoelectron spectroscopy (XPS) measurements. We found that the amount of W oxidation increases with the depth closer to the CeO<sub>2</sub> layer. In addition, as the annealing temperature increases to 600 °C, out-diffusion of Ce and La atoms to the bulk W, leading to the formation of Ce-O-W or La-O-W phases at the W/CeO<sub>2</sub>-La<sub>2</sub>O<sub>3</sub> transition layer, were observed. A quantitative analysis on the oxidation states of tungsten (i. e. W<sup>n+</sup>, with n=0, 2, 4, 5, and 6) were conducted by the Gaussian decomposition method. Results show that in the as-deposited sample the metallic W<sup>0</sup> (about 60%) is the majority content state. Other oxidation states such as W<sup>2+</sup>, W<sup>4+</sup>, W<sup>6+</sup>,

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