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PII: S0040-6090(17)30791-5
DOI: doi:10.1016/j.tsf.2017.10.029
Reference: TSF 36297

To appear in: *Thin Solid Films*

Received date: 19 May 2017
Revised date: 11 October 2017
Accepted date: 12 October 2017

Please cite this article as: Sarah Seidel, Lars Rebohle, Slawomir Prucnal, David Lehninger, René Hübner, Volker Klemm, Wolfgang Skorupa, Johannes Heitmann , Microstructure and charge trapping in ZrO2- and Si3N4-based superlattice layer systems with Ge nanoparticles. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Tsf(2017), doi:10.1016/j.tsf.2017.10.029

Microstructure and charge trapping in ZrO_2- and Si_3N_4-based superlattice layer systems with Ge nanoparticles

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Abstract

Ge was deposited on silicon as a superlattice with 10 layers of Ge embedded in Si_3N_4 or ZrO_2 matrices via plasma enhanced chemical vapor deposition or RF-sputtering, respectively. Raman spectroscopy, transmission electron microscopy and capacitance-voltage (CV) measurements were performed in order to investigate the structural and electrical properties of the superlattices. It will be shown that, in contrast to furnace annealing, flash lamp annealing of Ge-ZrO_2-superlattices leads to crystalline Ge nanoparticles in an amorphous matrix. As revealed by CV measurements, these layers show excellent charge storage capabilities. In comparison, a higher thermal budget is needed to crystallize Ge in case of Si_3N_4-based superlattices, and no significant charge trapping could be detected during CV measurements.

Keywords: Germanium; Nanocrystals; Zirconium oxide, Silicon nitride; Superlattice; Flash lamp annealing; Charge trapping