

## Accepted Manuscript

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PII: S0167-9317(17)30124-7  
DOI: doi: [10.1016/j.mee.2017.03.011](https://doi.org/10.1016/j.mee.2017.03.011)  
Reference: MEE 10501

To appear in: *Microelectronic Engineering*

Received date: 4 October 2016  
Revised date: 2 March 2017  
Accepted date: 27 March 2017

Please cite this article as: A. Carr, B. Peethala, M. Raymond, P. Adusumilli, V. Kamineni, C. Niu, A. Arceo De La Pena, D.F. Canaperi, S. Siddiqui, Impact of surface preparation for n-type Si:P and p-type SiGe:B semiconductors on low resistance silicide contacts. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Mee(2017), doi: [10.1016/j.mee.2017.03.011](https://doi.org/10.1016/j.mee.2017.03.011)

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## Impact of Surface Preparation for n-type Si:P and p-type SiGe:B Semiconductors on Low Resistance Silicide Contacts

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**Keywords:** X-ray photoelectron spectroscopy (XPS); contact resistivity; transmission line model; Si<sub>1-x</sub>Ge<sub>x</sub>

### Abstract

In our study, we evaluate effective silicon and germanium oxide reduction by two surface treatments to achieve low contact resistivity at the semiconductor/ metal interface. These chemistries, one alkaline and the other an acidic fluorine-based treatment, were utilized on epitaxial n-type Si:P and p-type Si<sub>1-x</sub>Ge<sub>x</sub>:B (x=0.47) substrates to isolate any unique effects that may be present on doped, n-type and p-type semiconductor surfaces. To mimic plasma damage and surface conditions in an integrated process flow for actual logic devices, X-ray photoemission spectroscopy (XPS) characterization was performed on simplified blanket films after NF<sub>3</sub>-based gas cluster ion beam (GCIB) exposure and subsequent aqueous treatments. Si:P and SiGe:B surfaces both demonstrated an increase in SiO<sub>2</sub> concentration after GCIB exposure, with SiGe:B surfaces showing a preferential SiO<sub>2</sub> surface oxidation. Subsequent acidic treatment showed reduction in SiO<sub>2</sub> concentration on both epitaxial surfaces, with the alkaline (basic) treatment showing little change in surface composition. Electrical characterization on simplified contact structures showed a benefit in contact resistivity of 15-23% in Si:P and 10-13% in SiGe:B for the chemistries evaluated.

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