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High resolution EELS study of novel semiconductor alloys: $Ge_{1-x-y}Si_xSn_y$ and $AlPSi_3$ LIYING JIANG, TOSHI AOKI, JOHN KOUVETAKIS, Arizona State University — Metastable alloys play a fundamental role in modern semiconductor science and technology as a major tool for band gap and strain engineering. When these alloys incorporate highly dissimilar materials, such as Si and Sn in $Ge_{1-x-y}Si_xSn_y$ alloys or III-V pairs in group-IV matrices, as in the new $(III\text{-}V)_x(IV)_{5-2x}$ systems synthesized by our group, the atomic distribution at the sub-nanometer scale is of paramount concern, since even slight deviations from randomness or from predicted ordered structures can have a dramatic impact on the electronic structure. Aberration-corrected microscopes provides the opportunity to generate atom-selective images with unprecedented structural and chemical detail. For this work, we used Electron Energy Loss Spectroscopy (EELS) to map the Sn distribution in $Ge_{1-y}Sn_y$ and $Ge_{1-x-y}Si_xSn_y$ alloys, as well as the distribution of Al and P atoms in $AlPSi_3$ to elucidate local bonding configurations and atom substitutionality. The EELS measurements also provide information on the electronic structure, which is compared with optical results and theoretical calculations.

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