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Heterogeneous and 3D Integration at DARPA

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<Abstract>
Next generation electronic systems face the challenges of signal interconnect in an increasing dense fashion will use diverse technology sets that requires an unprecedented level of complexity at the board, package and chip level. This paper will focus on the problems facing the commercial and defense community and how DARPA investments in heterogeneous and 3D integration are tackling this challenge. Work from the Diverse Accessible Heterogeneous Integration (DAHI) program will be the primary focus and will highlight the use of dielet bonding and wafer-scale bonding of CMOS with InP, GaN and GaAs for use in wideband RF and mixed-signal systems. Some of the challenges and successes of integrating a diverse set of compound semiconductors will be presented. Beyond DAHI, an overview of the Common Heterogeneous Integration and IP Reuse Strategies (CHIPS) program will be presented where the focus is on the reuse of CMOS dielet building blocks as an alternative to low-volume ASIC development. Finally, early work in the 3DSOC program will highlight how 3D monolithic integration may help break the memory wall at relaxed lithography nodes. Potential future directions for continued research will be discussed.

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Dr. Timothy M. Hancock joined DARPA as a program manager in September 2016 where his research interests revolve around RF microsystem development that spans semiconductor device processing, circuit design and system integration for communication, radar and electromagnetic spectrum sensing applications. Dr. Hancock is serving DARPA while on leave from MIT Lincoln Laboratory where he was an assistant group leader in the RF Technology Group and led programs in RF system design, RF & mixed signal integrated circuit design in CMOS and SiGe as well as material & device development for next generation RF GaN-on-Si and emerging ultra-wide bandgap semiconductors. In his first seven years at the Lincoln Laboratory as a staff member, he worked he developed low-power wireless devices for multiple applications and several multiple-input, multiple-output (MIMO) communication systems.
Dr. Hancock has published more than 25 papers and is a senior member of the IEEE, where he has served on the technical program committee for the Radio Frequency Integrated Circuits (RFIC) Symposium and the steering committee of the International Microwave Symposium. In 2010 he was inaugural recipient of the MIT Lincoln Laboratory Early Career Technical Achievement Award. Dr. Hancock earned the BS degree in electrical engineering from the Rose-Hulman Institute of Technology and the MS and PhD degrees in electrical engineering from the University of Michigan.