

## Fabrication techniques for heterogenous integration of 2.5-D Systems

M. David Henry, James Levy, James Bartz, Jon Sierra-Suarez, John Mudrick, Tom Friedmann, Matthew Jordan, Lauren Rowher, Douglas Trotter

In this work, we describe the fabrication of a focal plane array (FPA) subassembly utilizing a multi-chip system bonded onto a silicon wafer utilized as a motherboard where three different adhesion technologies and connection integrations are utilized for fabrication of an integrated FPA with supporting digital electronics.

When disparate materials or chips fabricated at different facilities, heterogeneous integration (HI) of the chips require advanced, and often challenging, methods. Techniques discussed for bonding in this work include: an In-In low temperature bonding utilizing a low gap, long lengths epoxy under fill, a plasma activated silicon dioxide to silicon dioxide aligned bonding, and Cu to Cu direct bond interface to couple die from different fabrication facilities. Challenges in the yield of each technique will be explored and discussed. An exemplar device will be presented demonstrating all three of the bonding techniques for combining a multiple electronic technologies.

SNL is managed and operated by NTESS under a DOE NNSA contract DE-NA0003525.