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2010 FLC Awards

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Awards for Excellence in Technology Transfer

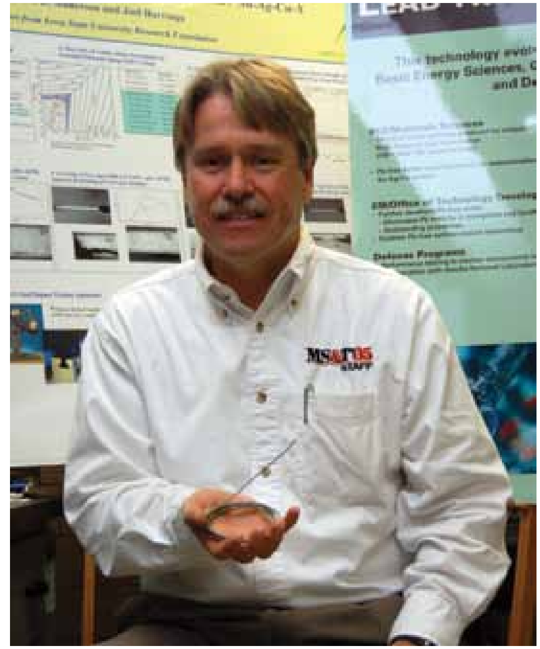
Lead-free Solder: A Revolutionary Solder Alloy

Department of Energy
Ames Laboratory

Dr. Iver Anderson and his team at Ames Laboratory developed a new metal for soft-soldering that combines tin, silver and copper in a novel alloy combination that is low melting, applies easily on typical metal joints, and has a reasonable cost. This revolutionary solder alloy replaces many uses of the traditional tin-lead low-melting solder, reducing further the number of lead toxicity hazards in our everyday environment. Of several lead-free alternatives, the Ames solder alloy formula is now considered a preferred lead-free solder by the worldwide electronics assembly industry, and can be found in many new consumer electronic items, including cell phones, TVs, and VCRs.

Long a proponent of technology transfer, Dr. Anderson worked directly with all three of the original licensees of the technology: Johnson Manufacturing of Princeton, Iowa; Loctite-Multicore Solders of Richardson, Texas and Great Britain; and Nihon-Superior of Japan to find new uses and make improvements. A subsequent sublicensing agreement greatly expanded the number of licensees to well over 60 worldwide, and gave industry and consumers an easy-to-use lead-free solder for many common uses. The rapid commercialization of this lead-free solder has helped reduce the amount of lead used in manufacturing electronics and other consumer goods, and has brought profits and jobs to the licensees and significant royalty income to Iowa State University and Ames Laboratory.

Ever since discovery of the tin-silver-copper solder, Dr. Anderson's group has worked to develop modifications to this base to improve the performance, ease of use, and durability. A subsequent patent was granted for additions, e.g., iron, cobalt, and other similar elements, to permit higher temperature applications of the solder. Most recently, the group has worked with Nihon-Superior support to pursue other solder alloy modifications, e.g., zinc, manganese and aluminum, that can give the tin-silver-copper solder joints enhanced impact resistance as well as high temperature tolerance. In fact, a manganese addition to a particular tin-silver-copper formulation also was found to reduce further the solder alloy melting point, and a patent application has been filed for this improvement. Such manufacturing improvements and higher performance can expand the range of possible consumer applications, for example, more rugged electronic sensors and control assemblies for SUVs and cars.



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VE-PSI: Virtual Engineering Process Simulator Interface

Department of Energy
National Energy Technology Laboratory

From left: Kenneth Bryden, Dr. Douglas McCorkle, Dr. Stephen E. Zitney, and Terry Jordan

The National Energy Technology Laboratory (NETL) and its R&D collaboration partners, Ames Laboratory and Reaction Engineering International, developed Virtual Engineering Process Simulator Interface (VE-PSI) software to facilitate the collaborative design of next-generation energy plants within a virtual engineering environment.

Meeting the increasing demand for clean and affordable energy while addressing climate change is arguably the most important challenge facing the world today. Using VE-PSI, energy plant design engineers can integrate, analyze, and optimize a wide variety of modeling and simulation data within an immersive, interactive, three-dimensional (3D) virtual environment. Such capabilities provide engineers with the ability to create virtual prototypes of new plant designs more quickly and efficiently, and at less cost than ever before, as well as improve existing designs before expending time and materials on physical prototypes. At NETL, system analysts are applying the VE-PSI technology to develop high-efficiency, near-zero emission plants such as the DOE's FutureGen coal-fired, gasification-based plant with combined-cycle electricity generation, and capture and sequestration of carbon dioxide emissions.

To facilitate effective technology transfer, VE-PSI is offered as open-source software within the Virtual Engineering Suite (VE-Suite), and it is available for download at http://www.vesuite.org. This has allowed flow of the technology to academia, national laboratories, and industry, as well as enabled a reverse flow of technology into VE-PSI from external researchers. At the DOE's Idaho National Laboratory (INL), researchers are applying VE-PSI to develop integrated virtual engineering simulations for bioenergy applications. Together with researchers from Ames, NETL is applying VE-PSI to couple Aspen Plus® process simulations and FLUENT® CFD equipment models with 3D plant-wide CAD models of integrated gasification combined-cycle (IGCC) systems in VE-Suite software. At ALSTOM Power, a major worldwide industrial player in equipment and services for power generation, design engineers are applying VE-PSI for a wide variety of advanced energy applications, including natural gas combined cycles, coal-fired oxy-combustion power plants, and chemical looping combustion and gasification systems.

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