Extending the Zinc(20) Family

Not long ago physicists Paul Canfield, Sergey Bud'ko and Shuang Jia discovered an exciting family of zinc(20) compounds that can be manipulated to take on the properties and behavior of other materials. (This research is described in "The Great Zinc Rethink," ***Inquiry***, spring 2007.) The highly tunable zinc(20) series, RT_2Zn_{20} (R=rare earth, T=transition metal, Zn=zinc), allows for many model compounds by substituting on either the rare-earth site or the transition metal site.

Now, expanding on that work, the research team has placed ytterbium, Yb, on the rare-earth site, making a half dozen YbT_2Zn_{20} compounds. "There are clear differences in how electrons in a normal metal like copper and electrons in the YbT_2Zn_{20} compounds behave," says Canfield. "Ytterbium is a rare-earth element that is a little schizophrenic. It's ambivalent, meaning sometimes it will display magnetism, and sometimes it will get rid of the magnetism totally."

By putting ytterbium on the rare-earth site in the RT_2Zn_{20} series, Canfield and his colleagues were able to make compounds that gradually lose their local moment magnetism at low temperatures. This happens, Canfield explains, when the conduction electrons rally around the Yb magnetic moments and collectively screen, or cancel, them out. This collective behavior of the electrons is called a correlated electronic state.

Using the fantastic tunability of the YbT_2Zn_{20} system, Canfield and his collaborators have been able to double the number of this type of correlated electron systems. "These are materials that have been poorly explored because there have been such a small number of them," he says. "By increasing the number of this type of correlated Yb-based compounds, we're able to start identifying systematic trends in their behavior. On top of that, we have five of these six new materials closely enough related that we can start appreciating the significance of subtle nuances in their properties."

A single crystal of YbT_2Zn_{20}

Rolls-Royce Acquires License to Use Turbine Blade Coating

Rolls-Royce Corp. has acquired exclusive rights to use a coating invented by Ames Laboratory researchers that helps turbines stand up to the heat in jet engines.

The unique bond coating will be applied to engine turbine blades made of nickel-based superalloys. Those superalloys are designed for strength but need help withstanding metal temperatures approaching 2,100 degrees Fahrenheit inside the hot section of a jet engine, says Ames Lab scientist Brian Gleeson, a coinventor of the coating.

The bond coating, based on a composition comprising platinum, nickel, aluminum and hafnium, improves the durability and reliability of a ceramic thermal barrier that's applied over the bond coat, says Daniel Sordelet, a senior scientist and group leader for the Ames Laboratory and a co-inventor of the technology, which won a prestigious R&D 100 Award in 2005.

Dr. William J. Brindley, the chief technologist for Rolls-Royce Corp., says, "This new coating offers excellent oxidation resistance. It's a new concept in coatings and a real step forward in understanding how and why coatings work. The technology also represents a remarkably quick transition from fundamental science to practical application."

Rolls-Royce, a world-wide provider of power systems for use in aerospace, marine and energy applications, will have an exclusive license to commercialize the inventions. Patents are pending for the inventions, and the term of the license agreement is for the life of any patents. The license has the potential to be an important source of revenue for the Iowa State University Research Foundation.

Daniel Sordelet and Brian Gleeson