



THE Ames Laboratory  
Creating Materials & Energy Solutions

## Breakthroughs from the Ames Laboratory

The Ames Laboratory has been changing and improving the lives of Americans for more than 60 years. As this list of Breakthroughs attests, Ames Lab scientific discoveries have led to new technologies that have impacted our lives in many ways.

### 1 Developed the process to produce high-quality purified materials

Developed the process that enables scientists to produce the purest rare-earth and other materials used in academic and industrial research today.



### 2 Set the standard for testing tools in analytical laboratories

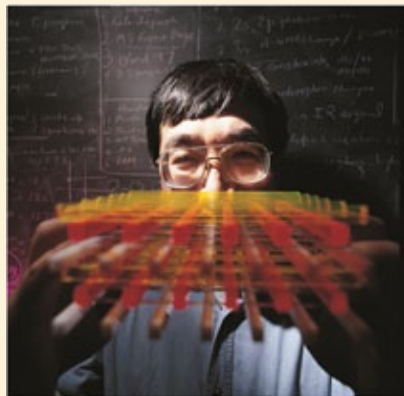
Some 17,000 analytical laboratories worldwide are reaping the benefits of pioneering work in inductively coupled plasma spectroscopy. An analysis tool developed from ICP research enables the rapid and accurate determination of up to 80 elements in metals, alloys and liquids, such as oil, serum, blood and soils. This determination is accurate down to levels of a few parts per trillion.

### 3 Invented a "smart" material

Scientists developed a novel smart material that has the ability to adapt to outside environmental influences. Terfenol-D is a magnetostrictive material that converts electrical power to mechanical power and vice versa. The material found its first use in sonar technology for the military but is now used in industrial applications.

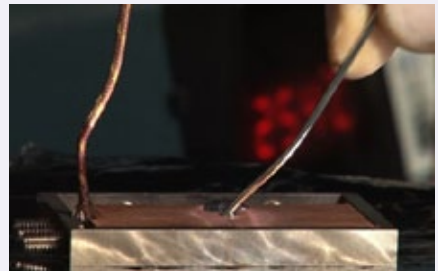
### 4 More efficient lasers

Scientists designed and demonstrated the existence of photonic bandgap crystals, which make it possible to develop more precise and efficient lasers.



### 5 Helped get the lead out of the environment

Industry has a new ally in its efforts to remove hazardous lead-based solders from the environment. Our lead-free alloy of tin-silver-copper has been widely adopted by the electronics industry for use in all types of devices, such as computers and cell phones. Lead-free solder has been licensed by more than 60 companies in the United States and around the world.



### 6 Tough glue that makes for stronger bonds in solar arrays

High heat conditions can be the enemy for maintaining strong bonds between ceramic composites used in the fabrication of solar arrays. A process developed for creating tough ceramic glue for joining continuous fiber ceramic composites promotes mechanical bond toughness in solar arrays at operating temperatures of up to 1800 degrees Celsius.



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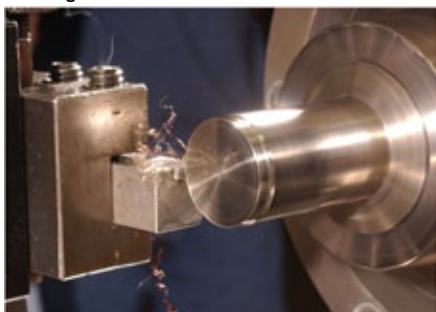
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# 7

## BAM, a new nano, tough and super-slick coating

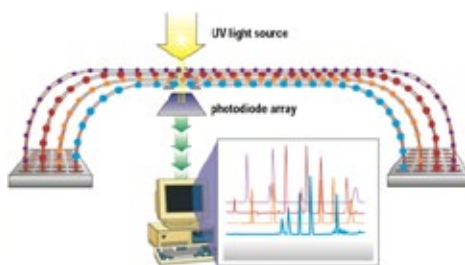
A ceramic coating made from an alloy of boron-aluminum-magnesium (BAM) can be applied to surfaces in industrial hydraulic pumps to reduce friction and increase wear resistance. The result: a potential reduction in U.S. industrial energy usage of 31 trillion BTUs annually by 2030 or a savings of \$179 million a year. The coating also has a second application as a friction reducer on industrial cutting tools.



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## The new standard for DNA sequencing

A technique that quantitatively analyzes the chemical content of a single human red blood cell has revolutionized the field of chemical analysis. Multiplexed capillary electrophoresis technology is now the standard analysis tool used for DNA sequencing.



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## Next-generation refrigeration technology


The next generation of refrigeration technology may get its "cool" from a material and, at the same time, help save the environment. Taking advantage of the magnetocaloric effect, an environmentally benign alloy of gadolinium-silicon-germanium could replace harmful chemical coolants as the cooling method in large supermarket chillers and air conditioners.



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## Helped chart the elements.

Helped researchers confirm the existence of element 106, seaborgium, a type of primordial plutonium

Rare Earths									
<ul style="list-style-type: none"> <li>- Research</li> <li>- Knowledge resources</li> <li>- High-purity metals &amp; materials</li> </ul>									
 <b>Ames Laboratory</b> <small>Creating Materials &amp; Energy Solutions</small> <small>U.S. DEPARTMENT OF ENERGY</small>									
1 H Hydrogen	2 He Helium	3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon	19 K Potassium	20 Ca Calcium
21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc
31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium
41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin
51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon	55 Cs Cesium	56 Ba Barium	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium
61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium
71 Lu Lutetium	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury
81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium
91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium
101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium
111 Rg Roentgenium	112 Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Lv Livermorium	116 Ts Tennessine	117 Og Oganesson	118 Uu Ununseptium	119 Uuq Ununquadium	120 Uuh Ununhexium

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## Left-handed materials.

Scientists helped create left-handed materials, which exhibit fascinating optical properties not found in naturally occurring materials. This discovery could help scientists create ultrahigh resolution imaging systems, with applications in aerospace, solar power and communications.



### CONTACT INFORMATION:

**Steve Karsjen**  
Public Affairs  
karsjen@ameslab.gov  
515-294-9557  
111 TASF, Ames, IA 50011-3020