

You Voted, We Counted: The 50 Greatest Moments in Materials, Part I: Nos. 50–11

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It is with great pleasure—and no small measure of honor—that this month's issue of *JOM* begins the two-part exercise of announcing the 50 greatest moments of materials science and engineering. We do this to not only recognize the impact of materials in our history but to celebrate the 50th anniversary of The Minerals, Metals & Materials Society as a member society of the American Institute of Mining, Metallurgical and Petroleum Engineers.

How did we create the list? First, we created a definition of what constitutes a great materials moment: "A Great Materials Moment is defined as a pivotal or capstone event of human observation and/or intervention that led to a paradigm shift in humanity's understanding of materials behavior, that introduced a new era of materials utilization, and/or that yielded significant materials-enabled socio-economic changes." Sounds right, eh?

Then, we invited dozens of esteemed materials professionals to tell us their views on great material moments; we examined the literature for more insight. These efforts yielded an inventory of more than 650 suggestions—a roster that we distilled into a list of 100 official candidates. This list was published in the November 2006 *JOM* (the cover story no less) and placed on a new web site dedicated to the project (www.materialmoments.org).

The next step was to open the list to on-line voting. The on-line voters were presented with a daunting task. First, they had to filter through a lengthy survey interface to record their votes (trust me, there is no simple way to present 100 complex candidate moments in a

concise and pithy fashion). Second, and more challenging, each person had to create his or her personal top ten. Choosing 10 great moments from a list of 100 worthy entries is not easy; ranking these ten in order of significance is a head-scratcher of the first order. Even



This logo for the Greatest Materials Moments initiative was created by TMS Graphic Designer David Rasel, who themed the artwork in the style of the distinctive etchings that populate the *De Re Metallica* by Georgius Agricola. The publication of Agricola's book is Moment 30 on our countdown.

for the most organized voter, I suspect that the survey required at least 30 minutes of intense effort to complete.

Despite the intellectual challenge and the time required, more than 900 individuals (materials students and professionals as well as the general public) completed the survey and, based on the comments submitted, seemed to revel in the task.

In early January, we closed the voting and began the process of analyzing the results. Converting the votes into an ordered ranking proved relatively simple by use of a weighting system: each first place vote that a moment received counted as ten points, each second place vote counted as nine points, and so on until we reached each tenth place voting counting as one point. Once the weights were assigned, we totaled the

points for each moment. The candidate with the greatest number of points became the Greatest Materials Moment.

For the moment, that moment will remain a secret.

We're saving the top ten for big-event unveiling during this month's TMS 2007 Annual Meeting & Exhibition in Walt Disney World. The announcement will be made during an all-conference plenary breakfast as TMS past presidents count the moments down from ten to one. The top ten will also be spotlighted at the *JOM* booth in the exhibit hall. If you can't make the scene at the Swan and Dolphin Resort, we will run the top ten in next month's issue.

In the meantime, you can enjoy (and start to debate) items 11 through 50, which you will find enumerated on the opposite page. I guarantee that as you read the list you will say at least once, and probably more than once, that "Moment *x* or Moment *y* should be a top-ten entry." Or something like "How can Moment *z* be so low?" Allow me to predict that more than one of you is going to say that about Moment 25: the Hall-Héroult Process. Others might say the same thing about Moment 18: the invention of bronze—an entire age of humanity is named for that development. Debating and second guessing the rankings should be one of the ongoing pleasures of the list. Please don't hesitate to send your comments to me.

About the only thing that you should not say is "Who voted for these things?" If your name is not part of the answer, well, you will get another chance when we do this again in about 50 years.

James J. Robinson is editor of *JOM*.

Rank	Moment	Date
50	A.A. Griffith publishes "The Phenomenon of Rupture and Flow in Solids," which casts the problem of fracture in terms of energy balance.	1920
49	Adolf Martens examines the microstructure of a hard steel alloy and finds that, unlike many inferior steels that show little coherent patterning, this steel had many varieties of patterns, especially banded regions of differently oriented microcrystals.	1890
48	Richard Feynman presents "There's Plenty of Room at the Bottom" at a meeting of the American Physical Society.	1959
47	Luigi Brugnatelli invents electroplating.	1805
46	Wallace Hume Carothers, Julian Hill, and other researchers patent the polymer nylon.	1935
45	Henry Clifton Sorby uses light microscopy to reveal the microstructure of steel.	1863
44	Paul Merica patents the addition of small amounts of aluminum to Ni-Cr alloy to create the first "superalloy."	1926
43	Leo Baekeland synthesizes the thermosetting hard plastic Bakelite.	1909
42	Potters in China craft the first porcelain using kaolin.	(estimated) 1500 BC
41	Kammerlingh Omnes discovers superconductivity while studying pure metals at very low temperatures.	1911
40	Friedrich Wöhler isolates elemental aluminum.	1827
39	The earliest form of metallurgy begins with the decorative hammering of copper by Old World Neolithic peoples.	(estimated) 8000 BC
38	Jack Kilby integrates capacitors, resistors, diodes, and transistors into a single germanium monolithic integrated circuit or "microchip."	1958
37	Alfred Nobel patents dynamite.	1867
36	Sumio Iijima discovers nanotubes, carbon atoms arranged in tubular structures.	1991
35	Russell Ohl, George Southworth, Jack Scaff, and Henry Theuerer discover the existence of p- and n-type regions in silicon.	1939
34	Hermann Staudinger publishes work that states that polymers are long chains of short repeating molecular units linked by covalent bonds.	1920
33	Abraham Darby I discovers that coke can effectively replace charcoal in a blast furnace for iron smelting.	1709
32	Sir Humphry Davy develops the process of electrolysis to separate elemental metals from salts, including potassium, calcium, strontium, barium, and magnesium.	1807
31	Glass blowing is developed, probably somewhere in the region of modern Syria, Lebanon, Jordan, and Israel—most likely by Phoenicians.	(estimated) 100 BC
30	Georgius Agricola publishes <i>De Re Metallica</i> .	1556
29	Metal workers in the Near East develop the art of lost-wax casting.	(estimated) 1500 BC
28	Max Knoll and Ernst Ruska build the first transmission electron microscope.	1933
27	Leon Guillet develops the alloying compositions of the first stainless steels.	1904
26	Cambridge Instruments introduces a commercial scanning electron microscope.	1965
25	Charles Martin Hall and Paul Héroult independently and simultaneously discover the electrolytic reduction of alumina into aluminum.	1886
24	Chinese metal workers develop iron casting.	(estimated) 200 BC
23	Egon Orowan, Michael Polyani, and G.I. Taylor, in three independent papers, propose that the plastic deformation of ductile materials could be explained in terms of the theory of dislocations.	1934
22	Otto Hahn and Fritz Strassmann find that they can split the nucleus of a uranium atom by bombarding it with neutrons.	1939
21	Augustin Cauchy presents his theory of stress and strain to the French Academy of Sciences.	1822
20	Niels Bohr publishes his model of atomic structure.	1913
19	Johannes Gutenberg devises a lead-tin-antimony alloy to cast in copper alloy molds to produce large and precise quantities of the type required by his printing press.	1450
18	Metal workers in the region of modern Syria and Turkey discover that addition of tin ore to copper ore before smelting produces bronze.	(estimated) 3000 BC
17	Werner Heisenberg develops matrix mechanics and Erwin Schrödinger invents wave mechanics and the non-relativistic Schrödinger equation for atoms.	1925
16	William Roberts-Austen develops the phase diagram for iron and carbon.	1898
15	Charles Goodyear invents the vulcanization of rubber.	1844
14	Pierre and Marie Curie discover radioactivity.	1896
13	Iron smiths forge and erect a seven meter high iron pillar in Delhi, India.	(estimated) 400
12	The earliest fired ceramics—in the form of animal and human figurines, slabs, and balls—(found at sites in the Pavlov Hills of Moravia) are manufactured starting about this time.	(estimated) 28,000 BC
11	J. Willard Gibbs publishes the first part of the two-part paper "On the Equilibrium of Heterogeneous Substances."	1876