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PRESS RELEASE

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Dr. Helmut Clemens, Head of the Department of Physical Metallurgy and Materials Testing at the Montanuniversität Leoben, Austria, Receives the Honda Prize 2014 for Contributions in the Development of Intermetallic Titanium Aluminides for the Next Generation of Eco-friendly Propulsion Systems

The Honda Foundation, a public-interest incorporated foundation created by Honda Motor's founder Soichiro Honda and his younger brother Benjiro Honda, is pleased to announce that the Honda Prize 2014*[1] will be awarded to Dr. Helmut Clemens for his outstanding contributions and eminent achievements in the development of light-weight structural intermetallic[*2] titanium aluminides, so-called γ-TiAl based alloys. The alloys and the processing technology developed by the research group of Dr. Clemens and his R&D partners, including MTU Aero Engines, Germany's leading aero engine manufacturer, are considered as key elements to be used in the next generation of advanced low-emission and fuel-efficient combustion engines.

Dr. Clemens is the Head of the Department of Physical Metallurgy and Materials Testing at the Montanuniversität Leoben in Austria. The university has defined its central fields of research as mineral resources, sustainable production and technology, and high-performance materials. Dr. Clemens is the 35th laureate of the Honda Prize. The award ceremony will be held at the Imperial Hotel in Tokyo on November 17, 2014. In addition to the prize medal and certificate, the laureate will be awarded 10 million yen.

Dr. Clemens is one of the internationally most renowned experts in the field of titanium aluminides. His activities and research on intermetallic γ-TiAl based alloys for more than two decades have significantly contributed to the fact that they are presently seen as key structural materials for high-temperature application in advanced jet and automotive engines of the next generation. Due to almost half the specific weight of TiAl alloys compared to presently used Nickel-base superalloys, improved design concepts can be applied to combustion engines. A considerable potential for saving fuel and reduction of CO_2 emission is a further consequence. In general, titanium aluminides have some shortcomings, that is, low ductility at room temperature and extremely difficult forgeability even at high temperatures. Within the framework of fundamental research programs, a new family of TiAl alloys termed TNM alloys, was developed by Dr. Clemens which exhibits adaptive properties, for example, "soft" when hot-worked and "hard" when used as structural components. For the first time a computer-aided method was applied to define the composition of an engineering TiAl alloy.

However, the potential of TiAl intermetallics cannot be fully exploited if no proper technologies are available to fabricate engine components, for example, turbine blades. Dr. Clemens has also set pioneering steps in this field. Due to the applied research activities, production steps like conventional near-net shape forging are now applicable for TiAl intermetallics. On top of that, in their forged and heat-treated condition, TNM alloys show approximately the double the strength of already used cast alloys, yet maintaining certain ductility at room temperature. The most advanced

experimental methods were applied to investigate the internal structure of the developed TiAl alloy from atomic to macroscopic scale. Furthermore, novel in-situ techniques were used to study technological processes, such as forging and heat treatments, in real-time. In addition to the experimental approach, extensive theoretical modeling was conducted both for effective alloy design and process development.

The intermetallic TiAl alloy developed by Dr. Clemens is currently undergoing validation and certification by one of the world-leading aero-engine manufacturers: Pratt & Whitney is going to use forged TiAl blades in its geared turbofan (GTF) engines for the Airbus A320neo aircraft and also Irkut MC-21.

The GTF PurePower® PW1000G engine family is a game-changing propulsion concept based on a new engine architecture. The new technology will reduce fuel consumption and CO_2 emissions, and will cut perceived noise levels by half compared with today's engines. The GTF engines for the A320neo and the MC-21 are being realized by Pratt & Whitney working with MTU Aero Engines and the Japanese Aero Engine Cooperation (JAEC). To all GTF engines MTU contributes the high-speed low-pressure turbine. The rear blade row of this turbine for the A320neo and MC-21 engines will be equipped with TiAl blades. Due to the higher rotational speed of the low-pressure turbine, the use of forged high-strength TiAl blades is absolutely essential.

In order to further extend the future potential of these innovative intermetallic materials, more applications in automotive and aero engines as well as other areas must be identified. The additional weight reduction will contribute to even lesser CO_2 and NOx emissions and improved fuel efficiency. To this end, future research shall be directed to further increase the high-temperature capabilities of TiAl alloys as well as to develop smart coating concept which will guarantee safe protection and lifetime of a component. Concurrently, reliable and cost-effective production routes as well as proper recycling technologies have to be established.

Established in 1980, the Honda Prize is awarded annually to an individual or group to recognize accomplishments in the field of ecotechnology*3, which works to advance human achievement while concurrently preserving the natural environment. New structural materials have to be "lighter and stronger" to withstand the extremely high demanding conditions in the next generation of automotive and aircraft engines, which are targeted to exhibit higher efficiency leading to reduced fuel consumption as well as significantly decreased CO_2 emissions. Intermetallic titanium aluminides are considered as key materials to meet this challenging goal. The alloys and processing technology developed by Dr. Clemens are among the goals of ecotechnology. Therefore, Dr. Clemens's contributions to the field are considered appropriate for the Honda Prize recognition.

*1 Honda Prize: Japan's first international science and technology award inaugurated in 1980.

*2 Intermetallic: Materials composed of two or more types of metal atoms, which exist as homogeneous, composite substances and differ discontinuously in structure from that of the constituent metals.

*3 Ecotechnology: Coined from "ecology"-the house of civilization –and "technology." It has been put forward since 1979 as the guiding philosophy for a better symbiosis between technology-driven civilization and nature.

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Dr. Helmut Clemens

Head of the Department of Physical Metallurgy and Materials Testing at the Montanuniversität Leoben, Austria

Born

July 26, 1957 in Klagenfurt, Carinthia, Austria (Austrian citizenship)

Education and Training

1997: Habilitation (Postdoctoral Lecture Qualification).
Subject: Intermetallic Materials; Montanuniversität Leoben
1987: Ph.D. (Dr. mont.), Montanuniversität Leoben, Materials Science
1983: M.S., Montanuniversität Leoben, Materials Science

Employment History

Montanuniversität Leoben, Professor, Head of the Department of Physical Metallurgy and Materials Testing, 7/2003 - present.
Helmholtz-Zentrum Geesthacht, Head of the Institute for Materials Research. Responsible for the areas "Metal Physics", "New Materials" and "Neutron Activities" in a joint appointment as Professor at the Christian Albrechts University of Kiel, 7/2000-6/2003.
University of Stuttgart, Professor, Institute of Physical Metallurgy, 3/1997-6/2000.
Plansee AG, Head of the R&D group "Intermetallic Materials", 2/1990-2/1997.
Montanuniversität Leoben, Research Assistant at the Department of Physics, 1987-90.

Biographical Sketch

Helmut Clemens is one of the internationally most renowned experts in the field of structural intermetallic materials, with particular focus on light-weight titanium aluminides, so-called γ-TiAl based alloys. The most important advantage of TiAl alloys is their almost half specific weight, when compared to the presently used Nickel-base superalloys. The alloys and processing technology developed by the research group of Dr. Clemens and his industrial partners are considered as key elements to be used in the next generation of eco-friendly combustion engines, where they partly replace heavy superalloys. Dr. Clemens is the Head of the Department of Physical Metallurgy and Materials Testing at the Montanuniversität Leoben in Austria. For his scientific contributions, Dr. Clemens was awarded the Rektor-Platzer-Ring of the Montanuniversität Leoben in 1983, the Georg-Sachs Prize of the German Society of Materials Science in 1995, the University Research Award of the Industry of the Austrian Industrial Society in 2006, and the Wolfgang-Houska Prize of the B&C Foundation, Austria, in 2010, among others.

Major Publications

Advanced Intermetallic TiAl Alloys: (with S. Mayer), Advanced Engineering Materials, Review Article, 2012.
Technology and Properties of Advanced γ-TiAl Based Alloys: (with several co-authors), Int. Journal of Materials Research and Advanced Techniques, 2009.
Neutrons and Synchrotron Radiation in Engineering Materials Science: (edited with W. Reimers, A.R. Pyzalla and A. Schreyer), Wiley-VCH, Weinheim, Germany, 2008.
Gamma Titanium Aluminides 2003: (edited with Y-W. Kim and A.H. Rosenberger), TMS, Warrendale, USA, 2003.