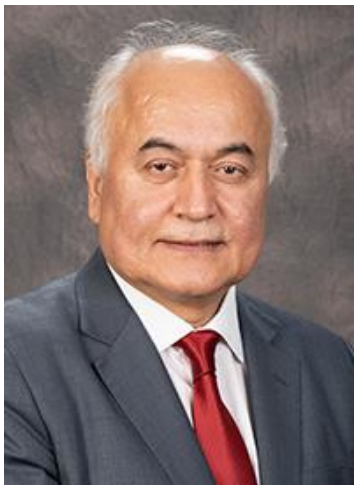
The Tribochemistry Award

Presented to

Dr. Ali Erdemir

In recognition of his outstanding contributions to tribochemistry by The Tribochemistry Technical Committee (Chair: Dr. Keiji Nakayama), Japanese Society of Tribologists (JAST) in September 2023 at “Tribochemistry Beppu 2023”.



Dr. Erdemir was born in Adana-Turkey in 1954. Following his undergraduate education at the Istanbul Technical University (from 1972 to 1976) and a short industrial employment, he moved to the United States for his graduate studies and obtained his Master and Ph.D. degrees from the Georgia Institute of Technology in Atlanta in 1982 and 1986, respectively. In 1987, he joined the Argonne National Laboratory as an Assistant Scientist and worked on a wide spectrum of tribology projects until 2019. In 2020, he accepted an academic position at Texas A&M University as a TEES Eminent Professor and a Halliburton Chair in the Mechanical Engineering Department.

Dr. Erdemir has dedicated his entire professional life (over 35 years) to the design, discovery and development of novel materials, coatings, and lubricants that can enhance energy efficiency, durability, and environmental compatibility of all forms of moving mechanical systems. Almost all of his research initiatives aimed at reducing energy and carbon footprints of these systems to help with global sustainability goals. Some of his major accomplishments include: (1) discovery of boron-based solid lubricants and lubrication additives; (2) discovery of near-frictionless carbon films and work on superlubricity; (3) nanocrystalline diamond and nanocomposite carbide derived carbon films; (4) superlubricious graphene films, (5) catalytically active nanocomposite coatings, lubricants, and additives, (6) large-scale ultra-fast boriding, and (7) upcycling of waste plastics into high-performance lubricants.

Dr. Erdemir's pioneering research work on boron-based lubricants started in 1987 and resulted in the discovery of new chemistries providing extreme resistance to wear and scuffing in tribological applications. His current research focuses on new variants of such lubricants including boron-based ionic liquids and oil-soluble borate esters that can trigger a special form of tribochemistry and hence superior lubricity and durability on moving mechanical surfaces.

Dr. Erdemir was also among the earliest pioneers of carbon-based tribological coatings including diamondlike carbon (DLC), ultrananocrystalline diamond (UNCD), carbide-derived carbon (CDC), graphene and other 2D materials. His work on DLC started back in 1988 and through very rigorous chemical and structural optimizations, his team synthesized a nearly frictionless version of DLC, providing friction coefficients down to 0.001 level (this was perhaps the lowest friction ever reported for a solid material at macro/engineering scales) in 1997. His dedicated research on these and other DLC films has unraveled the very rich tribochemistry of such coatings under dry and lubricated conditions and hence paved the way for numerous applications ranging from hard disk drives to a variety of automotive components. From early 1995 to 2010, Dr. Erdemir has also studied the friction and wear properties of UNCD and CDC films and confirmed for the first time that through some very unique tribochemical interactions, these coatings can provide some of the lowest friction and wear coefficients. One of Dr. Erdemir's other pioneering scientific endeavors has been in the field of graphene tribology. With his collaborators, he showed that even a few layers of graphene can reduce wear by more than 3 orders of magnitude and in combination with nanodiamond and DLC coatings, graphene can provide friction coefficients down to 0.004.

Dr. Erdemir's work on catalytically active nanocomposite coatings has started back in 2012 and yielded a groundbreaking discovery. Specifically, with his research team, Dr. Erdemir showed that these coatings can trigger a special kind of tribochemistry: they can catalytically crack long-chain hydrocarbon molecules of oils and deposit them on sliding surfaces as diamondlike carbon, graphene, and nanotube-rich boundary layers in a self-healing manner. In his latest research endeavors, Dr. Erdemir has been focusing on electric-vehicle tribology and exploring a new way to convert waste plastics into high-performance lubricants. The overall aim of these new initiatives is to reduce the adverse environmental impacts of internal combustion engines and of waste plastics being released to our environment and thus help with global sustainability goals.

Reflective of his sustained and pioneering research accomplishments over the past three decades, Dr. Erdemir has been elected to the National Academy of Engineering in the USA (one of the highest honors) and several other academies from around the world. He has also received the International Award of the Society of Tribologists and Lubrication Engineers, the Distinguished Tribologist Award of the Japanese Society of Tribologists, and the Mayo D. Hersey Award of the American Society of Mechanical Engineers. He has also been elected to serve as the President of the International Tribology Council from 2017 to 2022 and the Society of Tribologists and Lubrication Engineers from 2016 to 2017. He is a Fellow of AAAS, ASME, ASM-International, STLE and AVS and has authored/co-authored more than 240 refereed journal articles and presented over 200 plenary, keynote, and invited talks. He also holds 35 US

patents. He has contributed to the ITC and WTC satellite forums on Tribochemistry as a member of the International Advisory Board for many years.

In conclusion, Dr. Erdemir has contributed significantly to the development of tribochemistry through his pioneering research work from basic science to technological applications in multiple areas of tribology by developing advanced new approaches, especially those based on tribo-materials, tribo-coatings and lubricants.

With all these credentials, Dr. Erdemir is indeed a worthy recipient of the world's highest honor in tribochemistry – The Tribochemistry Award for 2023.