

2013 Acta Materialia, Inc. Gold Medal Award

The winner of the 2013 Acta Materialia Gold Medal is André Pineau, currently Emeritus Professor at the Ecole des Mines de Paris's Centre des Matériaux. André Pineau received an Engineering/Metallurgy degree from the Ecole des Mines de Nancy in 1965, and a PhD degree in Physical Sciences from the University of Nancy in 1969. He joined the Ecole des Mines de Paris in 1965, where he largely contributed to the creation of the Ecole des Mines's Centre des Matériaux. This Centre has become one of the largest of its kind in Europe specialized in the field of physics and mechanics of materials with about 200



people, including 90 PhD students. He was promoted to Professor in 1978 and was Head of the Ecole des Mines's Materials Science and Engineering Undergraduate Department from 1979 to 2006. He was responsible for the Centre des Matériaux's Mechanical Metallurgy Research Unit, associated with the National Scientific Research Centre of France (CNRS), from 1978 to 1994. From very early on in his career, he developed strong links internationally, e.g. with MIT, where he was twice a Visiting Professor at the Materials Science and Engineering Department (for a year in 72/73 and again for 6 months in 1983) working with Professors R. Pelloux, A. Argon and F. McClintock; with Kyoto University in 1977 where he collaborated with Professor I. Tamura on phase transformations in steels.

Professor Pineau's scientific career has been repeatedly recognized with prestigious awards and honors, including the *Rist Price* from the Société Française de Métallurgie (SFM) in 1974, the *Osmond Price* from the Société d'Encouragement pour l'Industrie Nationale (SEIN) in 1983, the *H. Becquerel Price* from the French Academy of Sciences in 1987, the *CNRS Silver Medal* in 1989, the *Portevin Medal* from the Société Française de Métallurgie et Matériaux (SF2M) in 1991, the *Gaz de France Price* from the French Academy of Sciences in 1992, the *Great Medal* from SEIN in 1994, the *Griffith Medal* from European Structural Integrity Society (ESIS) in 1996, the *Gold Medal* from the Federation of European Materials Societies (FEMS) in 1997, the *Honorary Medal* from the SF2M in 1999, and the *ASTM George R. Irwin Medal* in 2011.

His contributions have also been recognized with memberships of many scientific advisory boards and committees. Professor A. Pineau was elected as a member of the Comité des Applications of the French Academy of Sciences (CADAS) in 1994, of the French Academy of Engineering in 2000, and as a

fellow of the Société Française de Métallurgie et Matériaux (SF2M). He has also been a member of the Editorial Board of the journal on Fatigue and Fracture of Engineering Materials and Structures, and the editor of the Journal of Nuclear Engineering and Design. He was elected as Vice President of the European Structural Integrity Society (ESIS) in 2002, and as an Honorary Member of the Deutscher Verband für Materialforschung und –Prüfung (DVM) Society in Germany. He was a scientific advisor for Electricité de France (EDF) in 1994, for Usinor from 1998 to 2006, and has been for the French Atomic Energy Authority (CEA) since 1980. He has also served as an expert in numerous material and structural failure cases for the nuclear, transportation, pipeline, aeronautical and aerospace industries.

Professor André Pineau has published more than 300 journal articles, including 20 in *Acta Materialia* and *Scripta Materialia*, five textbooks, co-authored with D. François and A. Zaoui, and co-edited and co-authored 20 others dealing with the mechanical behavior of metallic materials. He is a passionate educator and has been an inspirational force to many undergraduate students, to the 85 PhD students who studied under his supervision and to his colleagues at the Ecole des Mines and at international institutions. As André Pineau has always been concerned with the education of school children, he is also currently strongly engaged in the development of practical scientific activities in elementary schools.

His early research was devoted to the study of the precipitation strengthening in nickel and iron base alloys. His main contributions in this field, with R. Cozar, were the discovery of the co-precipitation of γ' and γ'' phases leading to the "compact morphology" and to the development of a theory on the raftening of γ' precipitates in nickel base single crystals, work published in *Acta Metallurgica* in 1976. He was also involved (with B. Thomas, F. Lacroisey and L. Remy) in a pioneering study which identified the effects of temperature on the stacking fault energy of FCC metals and alloys. His research group also largely contributed to the understanding of the strengthening effect associated with mechanical twinning in low stacking fault energy alloys, such as Fe-Ni-Cr and also Fe-Mn alloys which form now the bases of TWIP steels used in the automotive industry. With R. Pelloux from M.I.T., he also investigated the effect of strain-induced martensitic transformation on the fatigue behavior of unstable stainless steels.

In the early 70s, he focused his research activities on high temperature fatigue and creep-fatigue oxidation interactions in nickel base alloys and austenitic stainless steels. His work (with E. Andrieu and R. Molins) showed in particular the existence of a critical oxygen partial pressure below which the fracture mode remains transgranular in Ni base alloys. He identified the mechanisms of oxygen

penetration along grain boundaries which are responsible for intergranular fracture of these materials, and the interactions between transgranular fatigue cracks and intergranular creep damage in stainless steels (with C. Levillant). The resulting understanding and approach has inspired to some extent the R5 assessment procedure for the high temperature response of metallic structures developed in the United Kingdom, in particular those used for the initiation of cracks by creep and fatigue damage. He also conducted a number of studies devoted to multiaxial fatigue, such as the effects of the environment and loading paths on the directional aspect of crack initiation.

In the 80s, André Pineau concentrated his research efforts on the study of fracture (ductile, brittle, ductile-to-brittle transition) in ferritic steels used for the fabrication of nuclear pressurized water reactors (PWR) and in duplex stainless steels. He developed the so-called "local approach to fracture" which is now widely used by engineers and scientists worldwide. This approach, which is mainly based on the micromechanisms of failure ahead of a crack tip, has largely contributed to the improvement of the transferability of laboratory test results to components. His work in this area over the past thirty years has greatly influenced the development of fracture mechanics standards (i.e. fracture toughness characterization and structural integrity assessments), and has thus had a profound impact in failure analysis, structural integrity code and material development in a broad range of industries, such as the automotive, aerospace, nuclear, pressure vessel and piping industries. In 1981, work by one part of his research group (also known as "Beremin") on cleavage fracture revealed for the first time that the fracture toughness of ferritic steels in the lower shelf regime is not an intrinsic property but depends on specimen size. Since then, the local approach to fracture methodology has become an established discipline in its own right, being largely used to explain a number of results which cannot be easily rationalized using a global fracture mechanics approach. André Pineau is continuing his work on the micro-mechanisms of fracture, in particular the effect of the bimodality of failure modes (cleavage and Intergranular damage) which can be found in thick components containing segregated zones, and the crossing of a grain boundary with a large twist component by a cleavage crack.

Professor Pineau will receive his Gold Medal during the December 2013 MRS Fall meeting in Boston, MA. A symposium, entitled "Materials: Fundamentals of Fatigue and Fracture", will be held in connection with this award.