Journal of Nuclear Materials 400 (2010) 1–2

Contents lists available at ScienceDirect

Journal of Nuclear Materials

journal homepage: www.elsevier.com/locate/jnucmat

The half-century of nuclear materials

Technologies are enabled by materials. For systems dependent on nuclear reactions for energy conversion and myriad additional applications, performance limits are essentially dictated by the capabilities of materials to withstand aggressive irradiation environments. Thus the quest to harness nuclear energy, "atomic energy" as it was more often called in the early years, rapidly propelled the field of materials forward. The Journal of Nuclear Materials is the home journal for the study of materials related to nuclear science and engineering. The years 2009 and 2010 are especially significant. In 2009 the Journal celebrated the 50th anniversary of its founding. Today we celebrate the publication of the 400th volume.

The Journal was conceived at the First and Second International Conferences on the Peaceful Uses of Atomic Energy, held in Geneva in 1955 and 1958, respectively. At that time the need became acute for a forum to provide for publication of materials research associated with nuclear reactors. Much of the work in materials for nuclear energy was then being declassified, international collaborations had been initiated, and new experimental data, theory and analyses were published. Authors of these manuscripts in wildly non-traditional topics submitted their manuscripts to various available journal titles, which generally did not present ideal fits for the new work. Worse, in too many cases the productivity of these researchers was documented only in internal institutional reports. People in the field had no home journal where they could access key information in their research areas.

With virtually perfect timing, the Journal was founded in 1959. "The Journal of Nuclear Materials will initially be published quarterly. It is planned to publish annually a volume of about 360 pages..." Thus reads a 1959 announcement of the North-Holland publishing company and the founding editors R.W. Cahn of the UK, J.P. Howe of the USA, and P. Lacombe of France. Could the founding editors and the publisher have known that the growth of the field and its home journal would be so extremely healthy today? For comparison, the 2010 program includes 36 issues in 12 volumes.

In the 1950s and building quickly in the subsequent decades, the parent field of materials science and engineering came into being as a unified discipline. Researchers in the field of nuclear materials were leaders in these developments. The Journal itself represents a model for the unification of materials science and engineering. Within these pages traditionally separate fields including metallurgy, ceramics, solid state physics and chemistry for nuclear applications were forged into the new disciplines of radiation materials science and more broadly nuclear materials science. Initially these fields were separated by wide chasms. Experimental equipment and techniques to study essentially similar phenomena were often not the same. University education, communications among researchers, conferences and workshops, and intangibles of the cultures were different. Even the terminology and mathematical notations to describe essentially similar phenomena were sometimes hardly recognizable across these field boundaries.

Two further essential unifying themes can be cited for which the Journal has made important contributions. Here there is a natural forum for the routine integration of basic and applied work. The purview of nuclear materials necessarily ranges from the most fundamental issues at the atomic scale to the performance of large engineered components in nuclear systems. Authors confront questions ranging from the physics of interatomic interactions, such as those in displacement cascades and fuel chemistry, to the meaning of these results for the materials behavior in components such as fuel rods, pressure vessels, fusion reactor first-walls and accelerator targets.

Again toward unification, the Journal strongly contributes to improved productivity by the elimination of unnecessary duplication of work. Materials for nuclear applications had focused initially on fission reactors. Subsequent developments in the field broadened this scope to include additional major nuclear areas. Early strategic decisions on Journal policy to report advances in research on fusion reactors and, much more recently, high power accelerators have been especially important. Speaking anthropomorphically, atoms in a fission reactor core, a fusion reactor first wall or a high power accelerator target, may not know in which system they reside but will know that they have been displaced from lattice positions by high energy particles. The subsequent evolution of nano-scale and eventually macro-scale features in each system is dictated by the same physical processes. Yet the material communities engaged in fission reactor, fusion reactor, and spallation target materials research have been largely, although not entirely, separate from each other in terms of topical conferences, institutional funding and scientific collaborations. By publishing the best work in these areas the Journal facilitates sharing of results and approaches, providing a fertile ground for scientific collaborations among these communities.

Researchers in nuclear materials have played leadership roles in the advancement of materials science. These contributions have occurred in many topical areas and are much too numerous to describe within the confines of the present editorial. One of the most prominent examples is in the area of computer simulation of basic materials behavior. Much has been written in the scientific literature about computer simulation and modeling being recognized

0022-3115/$ - see front matter © 2010 Published by Elsevier B.V.
doi:10.1016/j.jnucmat.2010.04.012

recently as the new "third branch of science". It joins up with the traditional branches of experiment and theory to provide a powerful battery of tools with which to understand materials behavior. Researchers in nuclear materials have been at the very front of this wave, no doubt because of the discrete atomic behavior that needs to be described as a result of energetic particle interactions with matter. The Journal has played a lead role for decades in the development of the third branch of science by actively encouraging the publication of manuscripts centering on computer simulation and modeling.

Established researchers and especially younger readers may find interest and inspiration in the history of the field as it has evolved. So that the reader notes something exceptional at first glance, the print version of the 400th volume exhibits a gold cover. Other historical markers, apropos for the early 21st century, are available only through our internet home page www.elsevier.com/locate/jnucmat. There, for example, we compile the 50 most highly cited papers in the past 50 years. In this way readers and authors have spoken on which are the most significant papers in our history. If a paper is on that list, then it is likely to be one of the pivotal papers published within these covers. However, if a paper does not appear on that list it nevertheless may be an important paper. Recent publications can be at a disadvantage in terms of total citations—enough time simply may not have passed to allow the accumulation of citations. Also, small subfields with relatively few researchers may not accumulate very high citations, although the corresponding papers may be crucial. With these qualifiers, this top 50 list serves to illustrate the remarkable breadth and depth of the Journal. At the same time these papers document the unique contribution of the Journal of Nuclear Materials toward establishing that branch of materials science now known as nuclear materials science.

For additional background, the first issue, J. Nucl. Mater. 1 (1959) contains both an introduction by Professor Francis Perrin of France on the origins of the Journal, and an "Editors' Notice", where the founding Editors describe their motivations and give an early scope for submissions. We have published editorials to mark each centenary volume. The 100th volume (1981) includes a preface to that special issue. That preface and the volume that it introduces was intended to help assure that readers, especially younger people in the field, did not, "...lose historical perspective and... forget by what stages the earliest metallurgical approaches led to the orthodoxies of today". The editorial for the 200th volume, J. Nucl. Mater. 200 (1993) v–vi, is entitled "The science and engineering of nuclear materials", which should itself recommend it for reading. In the editorial for the 300th volume, J. Nucl. Mater. 300 (2002) v–vi, key contributions of the Journal are highlighted and perspectives are drawn on changes from the inception years to the earliest part of the 21st century.

For the second half-century the Editors strive to enhance the value of the Journal of Nuclear Materials to the field of nuclear materials science. Grand challenges ahead include designing and constructing the next generation (Generation IV) and future advanced fission reactors, and developing and improving nuclear waste disposal concepts. In nuclear fusion technology similar challenges will be addressed through work at the International Thermonuclear Experimental Reactor (ITER) and future more ambitious concepts. Developing innovative long-lived targets for high power accelerators is yet another field that presents demands on the same grand scale. To cite a particular topic, materials issues in the fuel cycle, waste management and environment expand the required time scale to much longer than is normally covered by experimental research. This crucial area will require modeling and computer simulation of the highest order to predict materials behavior under conditions that are difficult to realize.

Readers are invited to share their thoughts for the future by communicating with the Editors.

L.K. Mansur
Oak Ridge, TN, USA

S. Ishino
Tokyo, Japan

R.J.M. Konings
Karlsruhe, Germany

C. Lemaignan
Grenoble, France

L. Werme
Uppsala, Sweden