

Preface 40 Years of Journal of Materials Science

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The Birth

Robert Cahn (1) traces the beginnings of the concept of materials science, now often referred to as 'MSE', to various developments that occurred in the United States in the 1950's. Among these a most important one was the creation of Interdisciplinary Research Laboratories to conduct research and development in MSE. These labs were designed to exploit the experience that groundbreaking innovations often depended on a close cooperation between physicists, chemists, metallurgists and engineers. Perhaps the best example at the time was the work at Bell Laboratories, which led to the invention of germanium and silicon transistors (2).

In laboratories where interdisciplinary cooperation flourished several areas of knowledge, e.g., phase equilibria, crystallography, the growth of single crystals, diffusion, microscopy, chemical analysis, were shown to be important in the study of a whole range of materials. Cahn coined a new word 'parepistemes' to emphasize the importance of these branches of knowledge, which together form the foundation of the discipline of materials science.

Chapman and Hall saw that by bringing together in a new journal papers dealing with different types of material the further development of these parepistemes would be enhanced. To this end a team of editors was assembled who between them could span a wide range of materials. Robert Cahn, the founding chairman of the Editorial Board, was a physical metallurgist and professor of materials science at University of Sussex. He was familiar with many of the modern metals and alloys that featured in the atomic energy programme. Freddy Clarke (AERE, Harwell) worked in ceramics; Andrew Keller (University of Bristol) on the physics of polymers; Peter McMillan (English Electric Co., Stafford) on glass and glass ceramics; Ron Bell (University of Southampton) on metals and semiconductors; Geoffrey Sims (University of Southampton) was an electronic engineer, whose branch of engineering had contributed so much to the founding of MSE and which was to continue to benefit hugely from investment therein.

Now in order for the cross-fertilization of ideas from one type of material to another to take place it was important for there to be a good representation of each field in every issue of the journal. This aim was a good companion to another aim, which was to establish the journal as a 'core journal' in MSE, viz., a journal that everyone working in MSE would feel that they must read. The managing director of Chapman and Hall at the time, Noel Hughes, was very conscious of the company's impeccable ethical standards and disapproved strongly of the exploitative practice of some scientific publishers of the day. Thus the growth of the journal was carefully managed so that all major topics and materials were covered on a regular basis whilst ensuring that the scientific and production standards were of a consistently high quality and provided good value for money. Just one detail will emphasize this: it was envisaged that half-tone illustrations arising from microscopy and electron microscopy would be a regular component of many papers and so to emphasize the care taken by the publisher to ensure high quality reproduction it was decided to make a feature of a cover photograph.

Scope and Impact

The first issue of *Journal of Materials Science* appeared in February 1966. The papers covered a broad range of topics from a study on orientation effects in polyethylene (3) to quantitative size-factors for metallic solid solutions (4). The latter paper, which reported size factors for 469 substitutional solid solutions using precision lattice parameter data and related these factors to a number of physical, chemical and mechanical properties of solid solution alloys, has amassed over 420 citations.

The first issue included a review article. These were judged to be a crucial function of the journal and reviews continued to be an important part of many issues. The most highly cited article published to date in *Journal of Materials Science* is the review by Ken Jack of the University of Newcastle upon Tyne on sialon and related nitrogen ceramics, which appeared in June 1976. When this review

article was written silicon nitride was a leading contender for gas turbines and other high-temperature engineering applications. Groups of researchers in Japan (5) and England (6) had independently discovered a new class of nitrogen ceramic called “sialons”. These were described as “ceramic alloys” and were phases derived from silicon nitrides and oxynitrides, which offered better prospects for technological exploitation. The review concluded with the statement: “the sialons offer exciting and almost unlimited prospects for scientific investigation and technological development.” Indeed significant amount of scientific investigation in these and other nitrogen ceramics has taken place, which account for the importance of this review article.

Another review that has had an important impact is that by Brian Lawn and Rodney Wilshaw, written when they were both in the Division of Materials Science at University of Sussex. This article discussed the basic principles and practical applications of indentation fracture. It sought to address what at the time was an area that was not well understood despite the fact that the scientific principles went back as far as the work of Hertz in 1881 (7). The indentation test had been widely adopted as a measure of a material’s “hardness” but the indentation-induced fracture patterns that were produced tended to be “viewed at best as something of a curiosity, more often as a disruptive element to be avoided at all cost.” The review was written at a time when there had been recent developments in the quantitative evaluation of indentation processes and where the indentation test was being considered as a tool for measurement of intrinsic fracture parameters of brittle solids (e.g., providing fracture-surface energies and crack-velocity functions). The authors had contributed much to the original work in the field of indentation fracture that formed part of this review and many of their papers had been published in *Journal of Materials Science* (e.g., 8–10). One of the reasons why this review has been so highly cited is that considerable research has been undertaken in indentation after 1975 (and much of it published in this journal e.g., 11,12). Another is the more recent development of nanoindentation (measuring mechanical properties of very small volumes), which has brought additional research interest and new groups into the field.

The top 10 most cited articles in *Journal of Materials Science* are listed below. Collectively they have been cited over 4,500 times.

- K.H. Jack, “Sialons and Related Nitrogen Ceramics”, *Journal of Materials Science* 11 (1976) 1135
- B. Lawn and T.R. Wilshaw, “Indentation Fracture: Principles and Applications”, *Journal of Materials Science* 10 (1975) 1049
- H.G. Scott, “Phase Relationships in Zirconia-Yttria System”, *Journal of Materials Science* 10 (1975) 1527

- A. Peterlin, “Molecular Model of Drawing Polyethylene and Polypropylene,” *Journal of Materials Science* 6 (1971) 490
- H.W. King, “Quantitative Size-Factors for Metallic Solid Solutions,” *Journal of Materials Science* 1 (1966) 79
- S. Matsumoto, Y. Sato, M. Tsutsumi, and N. Setaka, “Growth of Diamond Particles from Methane-Hydrogen Gas,” *Journal of Materials Science* 17 (1982) 3106
- M. Jarcho, C.H. Bolen, M.B. Thomas, J. Bobick, J.F. Kay, and R.H. Doremus, “Hydroxylapatite Synthesis and Characterization in Dense Polycrystalline Form”, *Journal of Materials Science* 11 (1976) 2027
- A.F. Yee and R.A. Pearson, “Toughening Mechanisms in Elastomer-Modified Epoxies 1. Mechanical Studies”. *Journal of Materials Science* 21 (1986) 2462
- P. Smith and P.J. Lemstra, “Ultra-high-Strength Polyethylene Filaments by Solution Spinning-Drawing”, *Journal of Materials Science* 15 (1980) 505
- F.F. Lange, “Transformation Toughening 1. Size Effects Associated with the Thermodynamics of Constrained Transformations”, *Journal of Materials Science* 17 (1982) 225

The first issue also contained two letters. These were short reports of current research. Letters still remain an important part of the journal and are once again published along with regular articles in each issue. The emphasis of the “letters” section is now more on providing an avenue for rapid publication of communications in areas that are of particular immediacy to the materials community. Authors of what were formerly short reports are now encouraged to write full-length articles.

When the journal was founded one of the goals was to provide a suitable place for publication of papers on composites. At the time there was no suitable journal for work on this materials class. Many of the papers in this current issue show that composites still form an important component of *Journal of Materials Science*.

The Future

In 2005 Springer took over as publisher of *Journal of Materials Science*. Springer is one of the leading international scientific publishing companies and ranks second in the world in the science, technology, and medicine sector. Along with the change in publisher, *Interface Science* was incorporated into *Journal of Materials Science*. The May 2005 issue was an *Interface Science* special issue containing papers from the Proceedings of the IV International Conference High Temperature Capillarity. During

2004/2005 several other special sections were published and these are listed below. Some of these were for selected conference proceedings while others were on focused topics of interest to the materials community.

- Electrophoretic Deposition: Fundamentals and Applications in Materials Science, Guest editor: A.R. Boccaccini, Volume 39, Number 3 (2004)
- Proceedings of the International Conference on Mechanochemistry and Mechanical Alloying 2003, Guest editors: V. Sepelák, K.D. Becker, and Z.A. Munir, Volume 39, Numbers 16/17 (2004)
- Ultra-High Temperature Ceramics, Guest editors: J. Fuller and M.D. Sacks, Volume 39, Number 19 (2004)
- Characterization of Ceramics, Guest editor: M.H. Lewis, Volume 39, Number 22 (2004)
- Proceedings of the 2003 International Symposium on Liquid Metals, Guest editors: P.D. Lee, A. Mitchell, A. Jardy, and J-P. Bellot, Volume 39, Number 24 (2004)
- Grain Boundary and Interface Engineering, Guest editors: T. Watanabe and S. Tsurekawa, Volume 40, Number 4 (2005)
- Photovoltaic Materials and Phenomena, Guest editor: A. Méndez-Vilas, Volume 40, Number 6 (2005)
- Proceedings of the Eleventh International Conference on Intergranular and Interphase Boundaries 2004, Guest editors: A.T. Paxton and M.W. Finnis, Volume 40, Number 12 (2005)

Journal of Materials Science remains one of the most consistently cited journals in the field. Over the last three years the total number of citations has continued to rise and for last year there were over 15,150 citations. This number ranked *Journal of Materials Science* fifth in total citations of all materials science-related journals in 2004.

The long-term impact of the journal is measured in terms of the cited half-life, which is > 10 years and shows that the articles published in *Journal of Materials Science* are used by researchers in the field many years after they first appeared. The consistent growth of the journal is testimony to the wisdom of the early principles on which it was founded.

Acknowledgments

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References

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3. I. L. HAY and A. KELLER, *J. Mater. Sci.* **1** (1966) 41.
4. H. W. KING, *J. Mater. Sci.* **1** (1966) 79.
5. Y. OYAMA and O. KAMIGAITO, *Japan J. Appl. Phys.* **10** (1971) 1637.
6. K. H. JACK and W. I. WILSON, *Nature Phys. Sci. (London)* **238** (1972) 28.
7. H. HERTZ, *J. Reine Angew. Math.* **92** (1881) 156; *Verhandlungen des Vereins zur Beförderung des Gewerbe Fleisses* **61** (1882) 449. Reprinted, in English, in "Hertz's Miscellaneous Papers" (Macmillan, London, 1896) Chs. 5, 6.
8. B. R. LAWN and M. V. SWAIN, *J. Mater. Sci.* **10** (1975) 113.
9. B. R. LAWN, *J. Mater. Sci.* **10** (1975) 469.
10. B. R. LAWN, T. R. WILSHAW, T. I. BARRY and R. MORRELL, *J. Mater. Sci.* **10** (1975) 179.
11. D. J. MORRIS, S. B. MYERS and R. F. COOK, *J. Mater. Sci.* **39** (2004) 2399.
12. J. THURN and R. F. COOK, *J. Mater. Sci.* **39** (2004) 4809.