DOI: 10.1595/147106707X192672

"Combinatorial and High-Throughput Discovery and Optimization of Catalysts and Materials"

CRITICAL REVIEWS IN COMBINATORIAL CHEMISTRY, Volume 1

EDITED BY RADISLAV A. POTYRAILO (General Electric Global Research Center, New York, U.S.A.) AND WILHELM F. MAIER (Saarland University, Germany), CRC Press, Boca Raton, U.S.A., 2007, ISBN 978-0-8493-3669-0, £115.00, U.S.$199.95

A Selective Review by Dave M. Newman* and M. Lesley Wears**

School of Engineering, Computer Science & Mathematics, Harrison Building, University of Exeter, Exeter EX4 4QF, U.K.;

E-mail: *d.m.newman@ex.ac.uk; **m.l.wears@ex.ac.uk

Introduction

A new book series begins with this volume, which covers molecular diversity and combinatorial chemistry, high-throughput discovery and associated technologies including characterisation techniques. Given the wide scope of this book, a comprehensive review is not possible. Therefore particular areas of interest having relevance to the platinum group metals (pgms) have been selected for a series of reviews. Here, Dave Newman and Lesley Wears of the University of Exeter, U.K., present a review of two chapters: respectively, Chapter 16, titled 'Innovation in Magnetic Data Storage Using Physical Deposition and Combinatorial Methods', by Erik B. Svedberg (Seagate Technologies, U.S.A.); and Chapter 17, 'High-Throughput Screening of Next Generation Memory Materials', by Chang Hwa Jung, Eun Jung Sun and Seong Ihl Woo (Korea Advanced Institute of Science and Technology, South Korea). Further chapters will be reviewed in future issues of *Platinum Metals Review*.

Thin Film Deposition for Data Storage Technology

Chapter 16 focuses closely on the thin film metal deposition techniques that have delivered the complex and task-tailored multilayer thin film structures that underpin the continuing and often spectacular advances in magnetic data storage technology. These are embodied in the hard disk drive now ubiquitous, not just in computer systems, but in reduced-size formats across the full spectrum of consumer electronics. The importance of optimising both material and multilayer performance, not only for the recording medium supporting the stored data, but also for the complex structures that comprise the readout sensor heads is referenced, but unfortunately this section is all too brief, so that the real challenges that have been met and overcome are not readily appreciated in full.

It is the comprehensive, detailed and well written descriptions of the deposition geometries directed to specific ends that provide the real benefit of the work. This section clearly describes the various deposition geometries by which material composition or thickness can be adjusted, to produce series of samples in which specific characteristics are varied in a highly controlled manner. It is supported by clear diagrams and photographs showing the relative dispositions of components in such systems. Concepts such as the movement of substrates and masks in complex patterns over multiply oriented sources are introduced and discussed, with reference to what might be achieved by way of compositional variation and the control of characteristics. A useful and illustrative example is given based on the development of cobalt/platinum (Co/Pt) and cobalt-chromium/platinum (CoCr/Pt) multilayers and, importantly, considerable effort is directed towards introducing the modelling of desirable magnetic-dependent parameters on material composition and thickness.

In summary, the chapter meets its stated aims and what it covers is well referenced. Its narrowness of scope is, however, disappointing. The increasing

importance of pgms to magnetic recording is not fully represented. No mention is made, for example, of the attempts to produce patterned media based on platinum-cobalt (PtCo) or platinum-iron (PtFe) by chemical and biological processes (1–5).

Screening of Thin Film Data Storage Materials

Chapter 17 promotes the use of a thin film deposition/characterisation procedure developed to enable rapid parallel characterisation of data storage materials. The conclusion, however, highlights the limits of this technology when applied to memory materials, due to the unavailability of high-throughput characterisation techniques. The diagrams and text are clear and concise, but the reader would benefit from the figures being close to the text that describes them.

The authors give an overview of current materials and techniques used by the storage industry. However, they fail to address the imminent problems facing the industry, which is surprising as these solutions involve pgms in particular. To increase the areal density of memory materials, the storage industry has committed to perpendicular recording. Although this is alluded to in the final section, where magnetoresistive random access memory (MRAM) and cobalt-chromium-platinum-tantalum (CoCrPtTa) are discussed, the failure to include heat-assisted magnetic recording (HAMR) (6), a technique which involves the deposition of high anisotropic materials which include PtCo and PtFe, may be considered an oversight.

Conclusion

Chapters 16 and 17 together provide a basic introduction to the often complex deposition technologies and operational methodologies now routinely employed in the manipulation and combination of material properties to a specific technological end. In this context they can be recommended; however reference to the importance of pgms is rather limited.

References

1 S. Sun, C. B. Murray, D. Weller, L. Folks and A. Moser, *Science*, 2000, **287**, (5460), 1989

2 B. Warne, O. I. Kasyutich, E. L. Mayes, J. A. L. Wiggins and K. K. W. Wong, *IEEE Trans. Magn.*, 2000, **36**, (5), 3009

3 T. J. Klemmer, C. Lui, N. Shulka, X. W. Wu, D. Weller, M. Tanase, D. E. Laughlin and W. A. Soffa, *J. Magn. Magn. Mater.*, 2003, **266**, (1–2), 79

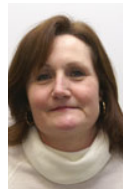
4 S. Wang, S. S. Kang, D. E. Nikles, J. W. Harrell and X. W. Wu, *J. Magn. Magn. Mater.*, 2003, **266**, (1–2), 49

5 K. Elkins, D. Li, N. Poudyal, V. Nandwana, Z. Jin, K. Chen and J. P. Liu, *J. Phys. D: Appl. Phys.*, 2005, **38**, (14), 2306

6 R. E. Rottmayer, S. Batra, D. Buechel, W. A. Challener, J. Hohlfeld, Y. Kubota, L. Li, B. Lu, C. Mihalcea, K Mountfield, K. Pelhos, C. Peng, T. Rausch, M. A. Seigler, D. Weller and X.-M. Yang, *IEEE Trans. Magn.*, 2006, **42**, (10), 2417

The Reviewers

Dave M. Newman, who reviewed Chapter 16, is Reader in Information Storage Materials and Technologies at the School of Engineering, Computer Science & Mathematics, University of Exeter, U.K.



M. Lesley Wears, who reviewed Chapter 17, is a Senior Research Fellow at the School of Engineering, Computer Science & Mathematics, University of Exeter, U.K.