

composites to replace metals in two-wheelers (Bajaj Auto Ltd) and (v) waterproofing system for beek bond PU22 (Beck & Co.) and sponsored ones which include: (i) perfumery products based on longifolene-capinone (Camphour and Allied Products Ltd), (ii) chlorobenzenes (Hindustan Organic Chemicals Ltd), (iii) dimethyl aniline (Sahayadri Dyestuffs and Chemicals P Ltd), (iv) acrylic acid/acrylates from acrylonitrile (Indian Petro Chemicals Corporation Ltd), (v) nitrile rubber (Synthetics and Chemicals Ltd), (vi) theophylline, amilophylline and caffeine (Pefco Foundry and Chemicals Ltd), and (vii) vinblastin sulphate BP/USP and vincristine sulphate BP/USP (Cipla Ltd). Among its failures listed therein are: (i) water evaporation control, (ii) ethylene oxide, (iii) enrichment of titanium dioxide in ilmenite, (iv) fumed silica, (v) high-grade silicon and (vi) rayon-grade pulp (Rural development, etc.).

The author gives again a summary of the issues faced by Indian scientists in conducting industrial research and transfer of technology to industry as required – the travails and tribulations as well within the contemporary techno-industrial policy regimes in two rather long chapters – ‘Walking through what is to come’ and ‘The agony and the ecstasy – brush with reality’. Quoting the famous words of Louis Pasteur, ‘No, a thousand times no; there does not exist a category of science to which one can give the name applied science. There are science and applications of science, bound together as the fruit to the tree which bears it’, the author truly elevates himself to a high S&T policy pedestal through his vastly acquired mastery over the subject as experienced in a less-developed society such as ours with an ‘overlapping culture’. Unable to summarize even the gist, one only recommends that any serious S&T researcher must read them at least a few times to gain any meaningful information of what is otherwise written and talked about as the ‘agony and ecstasy’ of true industrial research and successful technology transfers, including the warning of the late Prime Minister Indira Gandhi in her NCL Silver Jubilee address in 1975, ‘The Indian industrialists do not easily accept indigenous technology, however original. You must learn to be *evangelical* (emphasis added) in dealing with them!’ Whether the ‘industrialist’s attitude’ has changed over the decades, including those in the glo-

balized scenario towards one more favourable towards higher levels of self-reliance and national pride continues perhaps as a million dollar question!

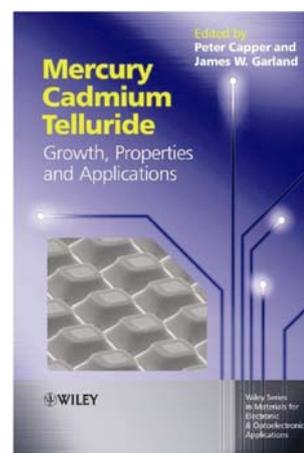
To conclude, this book is an invaluable addition to the very history itself of post-independent Indian S&T development in the civilian sector. The nation through CSIR has perhaps put its very best in NCL to make it a state-of-the-art R&D centre in scientific and industrial research. Could it rise up to the expectations to the extent needed or as projected through the Nehruian dream set on its Foundation Day? Could it have done more closely to it? Such answers can be found out only if analysed within the existing larger milieu of the national S&T and the controlling development policies. In other words, this book should serve to raise new and more serious questions on those aspects; and such an exercise could go a long way to make our civil sector R&D more relevant and development-friendly in its total sense, more so when the total regime has gone ‘liberal’ and global, with the Indian industry by and large going even less ‘evangelist’, to quote Indira Gandhi again. Every Indian will find this book an invaluable treasure in his library, to always refer in one’s onward journey in search of ‘excellence in an overlapping culture’ so widely pervading in our country. I have been engaged for the past several years to write through my educational website ([www.patentmatics.org](http://www.patentmatics.org)) on the ‘science and problems of development’, a term used by late Homi Bhabha to describe his ‘growing science’ theme, of our big science institutions like DAE, ICAR and ISRO from their respective contributions in self-reliance. Undoubtedly it was clear to me from such an odyssey that the voluminous monograph *In Pursuit of Excellence, A History of the Indian Institute of Science* by B. V. Subbarayappa, was a milestone in the field; this glorious work of L.K.D. far more deeper, quantitative and scholarly in content, should indeed be described as another major addition to our scarce store of such writings. Undoubtedly time has come for extending such efforts to many more of such pioneering units which have come up in our country in

many areas of specialization. Undoubtedly every research institute and S&T policy study centres in the country must keep a copy of this L.K.D. magnum opus for reference and study.

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**Mercury Cadmium Telluride: Growth, Properties and Applications.** Peter Capper and James W. Garland (eds). Wiley Series in Materials for Electronic & Optoelectronic Applications, John Wiley, UK, 2011. xxxiii + 556 pp. Price: US\$ 260.

Mercury cadmium telluride (MCT) is the dominant material for infrared sensing and imaging despite its many contestants. Some of its features, such as tailorable energy band gap over the entire infrared (1–30  $\mu\text{m}$ ) range, direct energy gap, high mobility of electrons, low dielectric constant, large optical absorption coefficient and long diffusion length, enable high quantum efficiencies (approaching 100% in most cases). Favourable inherent recombination mechanisms lead to long carrier lifetimes, low thermal generation rates, high operating temperatures and long diffusion lengths. Another ideal feature of the MCT band structure, only fully realized and

## BOOK REVIEWS

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exploited in the past 10 years, is that it enables the best electron-initiated avalanche photodiodes with single-carrier multiplication and no excess noise. The extremely small change in lattice constant with composition makes it possible to grow high-quality layers and heterostructures. MCT can be used for detectors operated at various modes and at temperatures ranging from that of liquid helium to room temperature.

The growth, properties and applications of this magical material have been presented in the book under review. The title of the book is appropriate, as it neither understates nor overstates the content. It covers the growth, characterization, processing, manufacturing of devices from and testing of MCT. However, other relevant substrates have also been included to give it the perfect finish. The book is aimed at postgraduate students, researchers and technologists engaged in the research, development and study of materials in electronics and photonics. It does not matter whether the readers are new to the area or established researchers. There is no other book in the market which covers the same topics in this comprehensive and effective manner. Hence, it is a jewel in one's collection on the subject.

The content is accurate on the technological front and includes all the results and data from previously reviewed work. It contains all the important technological concepts such as variations in the basic techniques to make the growth process more effective and faster, and the structural, thermal, mechanical, electronic, electrical and optical properties of MCT and related materials. It is important to be familiar with these properties before implementation, as they give an idea about the limitations and future prospects of the field. A few chapters affirm that there is no one material that is best for all applications. Thus, active research in search of appropriate substrates and materials must go on.

The book is divided into three major parts. The first part covers the growth and the myriad techniques and methods associated with the development of properties of MCT for special applications. This provides useful information for further improvements – to enhance sensitivity and resolution and also to lower manufacturing and operating costs. The

second part is a meticulous inclusion of the available gold standard characterization techniques. The basic experiments, along with related theory, to analyse the material physically and electronically are elucidated. The results presented here have also been verified using various theoretical models. Diffusion drastically affects the performance of a device and hence, identifying the diffusion mechanism is one of the important goals while making a device. The customary diffusion types are explained in this section in an easily understandable style.

While low-x MCT materials are gaining technological interest, the defects present are still a cause for concern. These defects have been elaborated in the book, but all the analyses provided are primarily empirical and are based on first-principal calculations. It suggests that this tricky field is open for exploration by theoreticians as well as experimentalists. Further in this section, passivation materials, methods and technologies for MCT have been discussed briefly. The characterization of narrow band gap semiconductors is strongly influenced by surfaces and interfaces. The surface potential can accumulate, deplete or invert the surface and thus have an adverse effect on the performance of a device. The book should have more content on passivation, as this is fundamental in the fabrication of MCT devices.

The section on manufacturing technology includes an extensive coverage of almost all facets. Some important manufacturing issues and plasma processes in the production of semiconductor materials in groups II–VI are presented in a brief but effective way. Molecular beam epitaxy and metal organic vapour phase epitaxy have enabled the production of new, complex MCT structures such as infrared imaging sensors with large (>1 megapixel format) focal plane arrays, small pixel sizes, high pixel densities, and even dual-band capabilities. Plasma processing enables anisotropic features and physical surface manipulation, which are not possible in wet chemical processes. Dry processes also allow a high degree of manufacturing process uniformity, run-to-run uniformity and user independence. Third-generation detectors, including two-colour arrays and structures with higher operating temperatures have been explained in the book, in a

manner that opens up further dimensions for research.

The third part of the book deals with the applications of MCT. All types of complex devices such as photoconductive, photovoltaic, dual band and emission devices, third-generation detectors and electron avalanche photodiodes have been dealt with fluency. The review chapters on dry processing and electron avalanche photodiodes are being presented for the first time, and so is the authentication of the plasma process and a new type of MCT device. This section encourages scientists and researchers to make plans for future work as there is scope to create milestones in the areas of infrared sensing and imaging.

The book has an abundance of experimental results with corresponding high-quality illustrations and graphs that would help researchers and students get a quick look at already accomplished work. All the illustrations are appropriate and well executed and enable one to compare various techniques and methods for growth and characterization. However, there are a few basic sections that require more illustrations and related data, especially for beginners. Otherwise, the book is well-structured, written and documented. The topics covered are easy to follow and include numerous examples. The best part of the book is the up-to-date reference collection, which would help readers to expand their knowledge and information base.

Both the editors are renowned scientists in this area and their research experience and expertise give a special flavour to the book. In addition, all the contributors are experts in their fields and are well-known internationally. In our opinion the book is a masterpiece and an outstanding collection of ample knowledge on the subject for everyone associated with this research area. One can look forward to meeting the new challenges and applications of MCT that may emerge.

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