Aperiodic-2000*

'Aperiodic-2000' is a continuation of the series of conferences on 'modulated structures, polytypes and quasicrystals'. The first meeting on 'Aperiodic crystals' took place in 1984 in Marseilles (France) and the second one was held in 1998 at the Banaras Hindu University (India). At that time it was known as 'MOSPOQ' (Modulated Structures, Polytypes and Quasicrystals). In 1991, the executive committee of the International Union of Crystallography (IUCr) approved the establishment of an *ad interim* Commission on Aperiodic Crystals. At the Beijing conference in 1993, IUCr became fully responsible for the future organization of international meetings on aperiodic crystals.

Nijmegen University at Nijmegen – one of the oldest cities in The Netherlands is the place where the concept of superspace structures was first advocated by P. M. de Wolf (*Acta Crystallogr. A*, 1974, **30**, 777; *ibid*, 1974, **33**, 493) and further propagated by A. Janner and T. Janssen, Chairpersons of this conference (*Phys. Rev. B*, 1977, **15**, 643). Nearly 125 participants from different parts of the world participated in Aperiodic-2000. There were five participants from India – S. Ranganathan (IISc, Bangalore), N. K. Mukhopadhyay and A. K. Pramanick (BHU, Varanasi), S. K. Choudhary (MD University, Rohtak) and A. Jain (Delhi University, New Delhi). The first two participants were invited speakers, the third participant gave an oral presentation and the last two participants presented their work in poster sessions. The technical programme of the conference had two tutorials, nineteen invited lectures, twenty-six contributed talks and two poster sessions, totalling 167 papers, which covered many aspects of quasicrystals (QCs), incommensurate crystals (ICs) and polytypes. In the following, we have attempted to highlight some new information and issues which generated stimulating and interesting discussions. Detailed information is available at the website – http://www.sci.kun.nl/tvs/aperiodic.

*A report on the triennial international meeting on aperiodic crystals, 'Aperiodic-2000', held from 4 to 8 July 2000 at the Department of Theoretical Physics, Nijmegen University, The Netherlands.

Definition problem

Currently, QCs are defined as solids exhibiting an axis of rotational symmetry that is forbidden in periodic crystals. R. Lifshitz (Israel) argued and advocated for a change of the current definition of 'QCs' to 'Quasiperiodic crystals' with two provisos, namely that (a) it is aperiodic, and (b) its diffraction diagram contains no clear subsets of strong Bragg peaks ('main reflections') and weak peaks ('satellites') to distinguish QCs from incommensurately modulated crystals. He emphasized that QCs may not necessarily have to exhibit crystallographically forbidden rotational symmetry. In support of this he demonstrated two-dimensional quasiperiodic tiling and also referred to the experimental observation of cubic QCs and tetrahedral QCs, where there is no forbidden rotational symmetry. It may be noted that the recent definition of aperiodic crystals adopted by the IUCr (*Acta Crystallogr. A*, 1992, **48**, 922) is 'Any solid having an essentially discrete diffraction diagram in which three-dimensional lattice periodicity can be considered to be absent'. Thus it appears from the deliberation that QCs can be understood as a special class of aperiodic solids.

Synthesis and growth

A. P. Tsai (Japan) for the first time, synthesized *P*-type stable icosahedral quasicrystals (IQCs) in $Cd_{60}Mg_{30}Dy_{10}$. He also reported another stable new IQC phase in $Cd_{85}Yb_{15}$. From the work of Tsai, the phase is known to be the first binary stable QC. M. N Mikheeva (Russia) reported a new QC, $Al_{70}Pd_{20}Tc_{10}$, containing technetium. It is a stable face-centred IQC with a quasilattice parameter 6.514 ± 0.004 Å. S. Ranganathan (India) compared and linked various crystalline structures such as those of vacancy ordered phases, gamma brass, hexagonal phases and various other intermetallics, and their relations with the decagonal structure. He proposed a unifying scheme to link the crystalline and QC intermetallics. This scheme appears to be useful to understand the rationale behind the synthesis of QCs and related intermetallics. The tutorial by M. A. van Hove (USA) dealt with the surface physics of aperiodic crystals. It included surface preparation and its impact on mesoscopic and nanoscopic surface structure. The possibility of connections with macroscopic properties of QCs, e.g. low friction, high hardness and low reactivity was also discussed. D. Joseph (Germany) presented a video recording of the growth of aperiodic structures on the basis of the tiling model. After discussing the effects of ideal and random tiling on growth, he compared the aforesaid model with that of periodic crystals. He felt that a distinction has to be made among single atom growth (atomic growth), cluster growth (tile growth) and growth involving competition among clusters which reach into the bulk (covering growth). Careful and well-planned experiments were suggested to resolve this issue.

Structure and stability

In his tutorial presentation, D. Gratias (France) discussed the basic concepts used for describing quasicrystalline atomic structures from the viewpoint of the cut and projection method, which was shown to provide an efficient way for generating atomic clusters. He discussed the generation of QC structures and their approximants by simultaneous decoration with Bergman and Mackay clusters, which is a new concept in QC structural models. Earlier models were based on Bergman or Mackay clusters separately as these are found in two different classes of QCs, viz. Mg–Al–Zn and Al–Mn–Si respectively. W. Steurer (Switzerland) presented a solution for structures of higher-order decagonal approximants. He pointed out that there is a close link between the decagonal QC and its higher-order approximants. A detailed database on QC called 'Quasicrystal on-line database' has been created by W. Steurer at the web address http://www.kristal.ethz.ch/QDB. Up to date information on QC structures, conferences and publications is available at this site. 'Diffuse intensity' and 'streaks' in the diffraction patterns of quasicrystalline materials were presented by N. K. Mukhopadhyay. Various kinds of ordering models for explaining these effects were discussed. A. K. Pramanick showed the presence of different types of ordering in Al–Co–Cu–Ni alloys by analysing their electron diffraction patterns. He discussed the results in terms of the *e*/*a* values of the alloys. Z. Papadopolos (Germany) considered the structural decoration of QC lattices in 3D space by Bergman and Mackay polytopes and showed that steps or traces at the surfaces involving three length scales could be predicted in the Al–Pd–Mn QC system. These distances, mutually scaled by a factor of τ, where $\tau = (1 + \sqrt{5})/2$, were shown to match with those observed experimentally by P. Theil and coworkers (USA).

K. Saitoh and coworkers (Japan) showed how the high-angle annular dark field scanning transmission electron microscope (HAADF-STEM) and atom location by channeling enhanced microanalysis (ALCHEMI) techniques could be used to obtain the local chemical information in the QC structure. HAADF-STEM method can provide STEM images using electrons scattered at high angles (~100 mrad). Since the scattering amplitude of the electrons is proportional to the square of atomic number (*Z*), the image shows *Z*-contrast. Using this technique, they proposed two types of atom clusters of 2 nm size in Al–Co–Ni decagonal phase. Based on ALCHEMI results, they proposed that Al and TM (transition metal) atoms occupy different sets of sublattice sites. Further, Ni and Co atoms either occupy different sets of sublattice sites or randomly occupy a similar set of sublattice sites. This observation would be helpful for solution of the decagonal QCs. A. Yamamoto and coworkers proposed a modified method of Low Density Elimination (LDE) for solving QC structures. The basic principle of LDE was to eliminate 'negative density' and 'sharpen the peaks in the electron density maps'; multidimensional LDE was used to solve the structure of QCs. Semi-quantitative models were presented for Al–Pd–Mn, Al–Co–Ni and Zn–Mg–Ho QCs, to provide a starting point for constructing a detailed atomic model of these QC systems. E. Rotenberg and co-workers (USA) carried out the photoemission studies on valence band structure of Al–Ni–Co and Al–Pd–Mn QCs, which has generated a lot of interest. This exciting work has also been reported in *Nature* (2000, **406**, 602). An Indian scientist, S. R. Barman (CAT, Indore) was also associated with this investigation. J. Roth (Germany) discussed the effect of shock waves on the stability of quasicrystalline materials. It was noted that weak shock waves reacted with the system elastically. In the intermediate range of shock waves, defect bands were produced, while for strong shock waves QCs and their approximant structures became amorphous.

In the category of IC structures, lectures covered modulated structures with different compositions and their related phase transitions, and electrical and magnetic properties of such materials. A. Yamamoto (Japan) dealt with procedures for 'automatic analysis of modulated and composite crystals'. H. Boysen (Germany) demonstrated how inclusion compounds affect diffuse scattering and satellite reflections in IC structure. This contribution concentrated on one-dimensional structures consisting of a three-dimensional framework (host), with a chain-like component (guest). The mutual interactions between host (e.g. *n*-alkane) and guest (e.g. urea) molecules resulted in modulated structure. J. F. Kelly and coworkers (England) studied the diffraction contrast obtained from the edge of hexagonal crystals of silicon carbide (SiC) with the help of synchrotron radiation source X-ray diffraction edge topography (SRS-XRDET). They proposed a 'sandwich model' for non-degenerate polytype–polytype configuration in SiC structure. It was noted that besides such long-period ordered structures, one-dimensional disorder was also prevalent in SiC.

During the concluding session it was proposed to bring out the conference proceedings which will be dedicated to the memory of P. M. de Wolf for his pioneering contribution to this field. The proceedings will be published as a special issue in *Ferroelectrics*. The next international meeting is scheduled to be held in Brazil in 2003.

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RESEARCH NEWS

Gene targeting: Exciting breakthroughs in flies and mammals

Hina Patel and Pradip Sinha

One of the goals of genetic engineering is to transfer cloned genes in the germline of desired organisms. This is done by transfer of exogenous DNA, or a transgene, into a developing embryo or into the nucleus of an egg which then integrates into the host genome. Integration of a transgene in the host genome in this case is a non-homologous recombination event since the former does not generally carry sequences matching those of the recipient organism. Ran-