News

Materials Researchers

Photo courtesy of The Ames Laboratory, USDOE.

Materials Researcher Dan Shechtman receives Nobel Prize for discovery of quasicrystals

Dan Shechtman, the Philip Tobias Professor of Materials Science at the Technion—the Israeli Institute of Technology, has been awarded the 2011 Nobel Prize in Chemistry for his discovery in 1982 of quasicrystals.

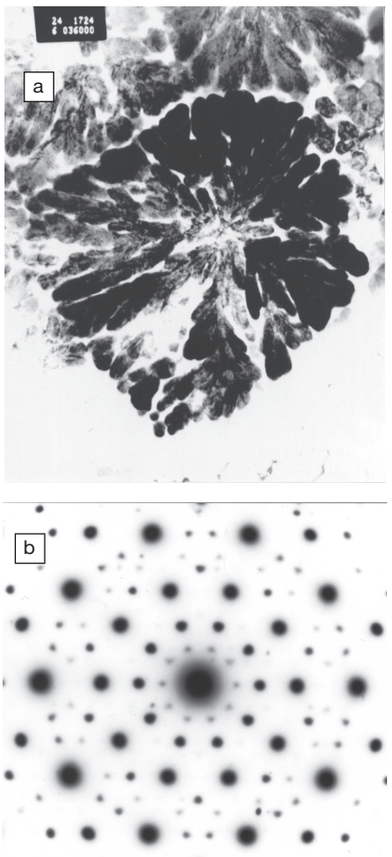
In solid crystalline materials, atoms were believed to be packed in ordered symmetrical patterns that were *repeated periodically*. For scientists, this repetition was required in order to obtain a crystal. It was furthermore understood that translational symmetries with two-, three-, four-, and sixfold axes were possible, while five-, seven- and all higher symmetries were not.

Shechtman discovered a crystal that displayed a tenfold diffraction pattern, and showed that the atoms in his crystal were packed in a pattern that could not be repeated. Shechtman made this discovery during his two-year sabbatical in the United States at the National Bureau of Standards (now the National Institute of Standards and Technology), where he studied a series of rapidly solidified aluminum alloys. While observing one of these alloys with 25 wt% manganese using a transmission electron microscope, he was taken by surprise with the tenfold diffraction pattern (see Figure). By further studying the crystal in various orientations and through a series of different diffraction patterns, a series of dark-field images, and numerous microdiffraction patterns, Shechtman ruled out the possibility of a multiply-twinned crystal. He recognized that he had come upon a new discovery, which also eventually proved to be extremely controversial.

When Shechtman returned to the Technion, he collaborated with x-ray expert Ilan Blech in the fall of 1983. They formulated a structural model that, when Fourier-transformed, gave rise to the two-, three-, and fivefold symmetries identical to Shechtman's earlier TEM patterns. Through further discussions with other researchers, including John Cahn at the Bureau of Standards, Shechtman and his colleagues began publishing articles on this discovery, most notably, the seminal article that appeared in *Physical Review Letters* **53** (20) (1984) p. 1951 that was the basis for his Nobel Prize.

Along with the controversy that ensued, the publications launched further studies across disciplines to account for Shechtman's discovery. In time, crystallographers and the broader scientific community accepted this finding, and the definition of "crystal" given by the International Union of Crystallography was changed. In essence, Shechtman's work changed textbook science as it separated order from periodicity when talking about crystals and crystallography.

Shechtman received his BSc, MSc, and PhD degrees from the Technion where he then joined the Department of Materials Engineering in 1975. He has also been an Iowa State University professor of materials science and engineering and a research scientist for Ames Laboratory in the United States since 2004. Among his other honors are the European Materials Research Society (E-MRS) 25th Anniversary Award (2008); election to the European Academy of Sciences (2004), the American National Academy of Engineering (2000), and the Israel Academy of Sciences (1996); and honorary membership to the Materials Research Society of India in 1997.



(a) The first observed icosahedral particle and (b) the corresponding tenfold diffraction pattern.

Correction

In the August 2011 issue of *MRS Bulletin*, p. 606, the caption for Figure 4a should have also included: The cable system, including six outdoor terminations for connection to LIPA's grid, was designed, manufactured, and installed by Nexans.

https://doi.org/10.1557/mrs.2011.304 Published online by Cambridge University Press