Martin Fleischmann

(1927–2012)

Pioneering electrochemist who claimed to have discovered cold fusion.

Although a final reckoning should not let genuine achievements be overshadowed by errors, the blot that cold fusion left on Martin Fleischmann's reputation is hard to expunge.

Fleischmann, who died on 3 August at the age of 85 after illness related to Parkinson's disease, heart disease and diabetes, was the first to observe enhanced Raman emission from molecules at surfaces, now the basis of a spectroscopy technique. And he developed ultramicroelectrodes, used as sensitive electrochemical probes.

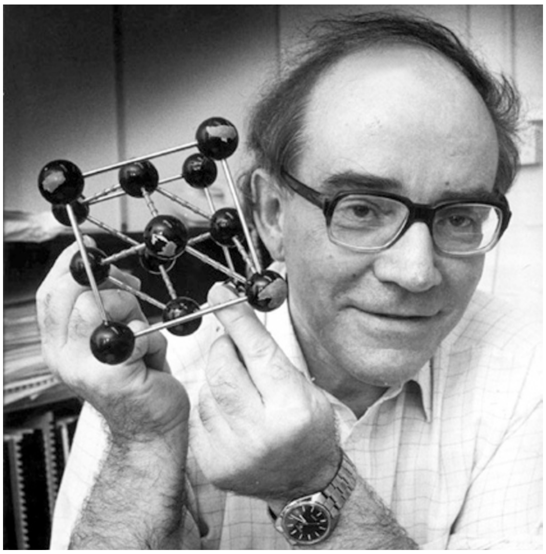
Nonetheless, he is best known for his claim in 1989 to have initiated nuclear fusion in bench-top apparatus. The 'cold fusion' debacle provoked bitter disputes that reverberate today. Along with polywater and homeopathy, cold fusion is now regarded as one of the most notorious cases of what chemist Irving Langmuir called pathological science: "the science of things that aren't so".

Cold fusion was not really an aberration for Fleischmann, but an extreme example of his willingness to suggest bold and provocative ideas, to take risks and to make imaginative leaps that could sometimes yield a rich harvest.

Fleischmann was born in Carlsbad in Czechoslovakia in 1927. His father was of Jewish heritage, and, just before the German invasion, his family fled to the Netherlands and then to England. Fleischmann studied chemistry at Imperial College London and, after a PhD in electrochemistry, moved to Newcastle University, UK. In 1967 he was appointed as the Faraday Chair of Chemistry at the University of Southampton, UK.

In 1974, Fleischmann and his co-workers observed unusually intense Raman emission (scattered light shifted in energy by interactions with molecular vibrational states) from organic molecules adsorbed on the surface of silver electrodes. Although the enhancement mechanism is still not fully understood, surface-enhanced Raman spectroscopy has become a valuable tool for investigating surface chemistry.

Around 1980, Fleischmann and chemist Mark Wightman independently pioneered the use of ultramicroelectrodes just a few micrometres across, which can be used to study electrode processes that are otherwise inaccessible, for example at low electrolyte concentrations. In 1985, Fleischmann was elected a fellow of Britain's Royal Society.



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The cold fusion experiments arose out of Fleischmann's long-standing interest in hydrogen surface chemistry on palladium. Hydrogen molecules adsorbed onto palladium can diffuse into the metal lattice, making palladium a 'sponge' that soaks up large amounts of hydrogen. Very high pressures can build up — perhaps, Fleischmann speculated, high enough to fuse hydrogen nuclei.

Fleischmann's retirement from Southampton in 1983 freed him to conduct self-funded experiments at the University of Utah in Salt Lake City with his former student Stanley Pons. They electrolysed solutions of lithium deuteroxide, collecting deuterium at the palladium cathode, and claimed to measure more heat output than the energy fed in — a signature, they said, of deuterium fusion within the electrode. One morning, they found that apparatus left running overnight had been vaporized and the fume cupboard destroyed. They believed it was the result of a violent outburst of fusion.

Not until 1989 did Fleischmann, Pons and their student Marvin Hawkins make a move to publish their data. Finding that they were in competition with a team led by physicist Steven Jones at Brigham Young University in Provo, Utah, Fleischmann and Pons initially accused Jones of stealing their ideas. But the groups agreed to coordinate their announcements and to submit papers simultaneously to *Nature* on 24 March 1989. Yet Fleischmann and Pons pre-empted that arrangement, rushing a second paper to the *Journal of Electroanalytical Chemistry*, organizing a press conference on 23 March and faxing their manuscript to *Nature* the same day without telling Jones.

The rest, as they say, is history, told for example in Frank Close's *Too Hot To Handle* (W. H. Allen, 1990). Fleischmann and Pons's announcement shocked the world. Chemists had apparently, at minuscule expense, solved the fusion problem that physicists had been working on for decades. In the attendant flurry, Fleischmann and Pons professed to be too busy to address reviewers' comments and withdrew their *Nature* paper; Jones's account was eventually published (S. E. Jones *et al. Nature* **338,** 737–740; 1989). Despite sporadic claims to the contrary, no comprehensive attempt at replication produced any confirmation of fusion.

Indeed, it was a lack of reproducibility that finally put paid to the cold fusion idea. More bad behaviour followed: Fleischmann refused to describe crucial control experiments; Pons's lawyer threatened to sue a Utah physicist who reported in *Nature* (see M. H. Salamon *et al. Nature* **344,** 401–405; 1990) that he was unable to replicate the work. The University of Utah sought to capitalize on events, throwing US$5 million at a 'National Cold Fusion Institute' that closed two years after it opened.

Fleischmann and Pons moved to France to continue their work with private funding, but later fell out. The biggest casualty of cold fusion was electrochemistry itself, suddenly seeming to be exposed as a morass of charlatanism and poor technique. That was unfair: some of the most authoritative (negative) attempts to replicate the results were conducted by electrochemists.

Fleischmann's tragedy was Shakespearean, not least because he was a sympathetic character: resourceful, energetic, inventive and remembered warmly by collaborators. As Linus Pauling and Fred Hoyle experienced, once you have been proved right against the odds, it becomes harder to accept the possibility of error. To make a mistake or a premature claim, even to fall prey to self-deception, is a risk any scientist runs. The test is how one deals with it. ■

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