OBITUARY

Alan Graham MacDiarmid (1927–2007)

Pioneer of conducting polymers, and proud Antipodean.

Alan MacDiarmid, who died on 7 February, was a pioneer of the field of intrinsically conducting polymers. He was born on 14 April 1927 in Masterton on the North Island of New Zealand. His Nobel autobiography describes a relatively frugal upbringing in a loving and generous family. When extra guests were invited back to the MacDiarmid home for a welcoming meal, the family was instructed to “FHB” — family hold back — while the guests were fed first. This isolated and caring Antipodean environment shaped a generosity of spirit in MacDiarmid that was appreciated by all who came into close contact with him.

MacDiarmid left high school aged 16 and put himself through the then Victoria University College, Wellington, studying part-time while working as a lab boy. A Fulbright scholarship to the University of Wisconsin followed, where he completed a PhD under Norris Hall, and then won a New Zealand Shell scholarship to work on silicon hydrides with Harry Emeléus at the University of Cambridge, UK. With characteristic modesty, MacDiarmid described this opportunity as one he could not miss, even though it meant his studying for a second PhD. The terms of the scholarship also demanded that he remained single; eventually, however, he was able to marry Marian Mathieu in the chapel of Sidney Sussex College, Cambridge.

After a brief spell at the University of St Andrews, UK, MacDiarmid entered the chemistry department at the University of Pennsylvania in Philadelphia in 1964, where he remained essentially until his death. There, he met the condensed-matter physicist Alan Heeger, who suggested a collaboration on conductors that he described as SN_x. These were inorganic covalent materials containing sulphur and nitrogen, (SN)_x. MacDiarmid was initially unimpressed, assuming that everyone would know that metallic tin, (Sn)_x, was conducting.

The encounter led to collaboration and lifelong friendship, culminating in the award of the 2000 Nobel Prize in Chemistry to Heeger, MacDiarmid and Hideki Shirakawa. Shirakawa's involvement was serendipitous: MacDiarmid had presented a seminar on conducting (SN)_x materials at the Tokyo Institute of Technology in 1975, which Shirakawa did not attend because (SN)_x was not his area, and he had missed the ‘conducting’ qualifier. Meeting after the seminar, Shirakawa showed MacDiarmid a silvery film that he had prepared by polymerizing acetylene, C₂H₂, in a toluene solvent with differing ratios

of catalyst. Realizing the significance of this ‘polyacetylene’, MacDiarmid invited Shirakawa back to Philadelphia, soliciting funding support from Kenneth Wynne at the US Office of Naval Research. This funding decision was surely one of the most far-sighted of the period.

Together at Pennsylvania, MacDiarmid and Shirakawa first investigated improving the conductivity of polyacetylene by washing out impurities — but the purer the polymer became, the lower was its conductivity. They next tried to modify the polyacetylene with bromine, as had been done with (SN)_x, and observed an increase in conductivity. But it was when, in collaboration with Heeger and his group, they tried iodine that the real surprise came. Astoundingly, the iodine-doped polyacetylene showed a conductivity of 30 siemens per centimetre, an increase of seven orders of magnitude over the undoped material. The first conducting polymer had been produced.

Until that point, polymers had been regarded as excellent insulators, and the work changed the way scientists thought about plastics. Enormous interest in conducting and semiconducting polymers immediately followed. Improved and elegant precursor routes to polyacetylene were developed, and its conductivity was increased to a level almost as good as that of metallic copper, around 10³ S cm⁻¹. All sorts of optoelectronic applications — transistors, solar cells and polymer light-emitting devices — have been the result.

When Heeger moved to Santa Barbara in 1982, MacDiarmid continued fruitful collaborations with many others, opening up the field of polyanilines and related stable, soluble conducting polymers with controllable properties. During his scientific career, he influenced many people with his enthusiastic and enquiring approach, and his generosity of spirit. That warmth extended not just to his close collaborators: he was always to be seen at conferences asking a speaker or a student presenting a poster an encouraging question that made them feel good about their work.

Although he lived and worked in the United States, Alan MacDiarmid treasured his Antipodean roots. He loyally supported science throughout the Asia-Pacific region: in New Zealand, where his achievements were honoured with the naming of the MacDiarmid Institute for Advanced Materials and Nanotechnology in Wellington; in Australia, where he chaired the international advisory committee for

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the University of Wollongong's Centre of Excellence in Electromaterials Science; and in China, through the MacDiarmid Laboratory at Jilin University. In the last four years of his life, he held two positions, at Pennsylvania and the University of Texas, Dallas, where his attention increasingly turned to climate change, and particularly the use of biofuels.

Alan enjoyed life to the full. At the biennial International Conference on Synthetic Metals, of which he was a founding member, and at many other international events, he could be relied on to demonstrate his version of the *haka*, an indigenous New Zealand war dance. MacDiarmid — pictured here with his Nobel medal at the University of Wollongong in 2001 — was a recipient of many honours in his later life. He was appointed as one of the only 20 concurrently living members of the Order of New Zealand in 2001, and was a member of the US National Academy of Sciences and a fellow of the Royal Society of London. In 2002, he received an honorary doctorate from the University of Cambridge, and was inducted an honorary fellow of Sidney Sussex College in the chapel where he was first married.

Marian, Alan's wife from that marriage, died in 1990. After a 14-year courtship he was married again, to Gayl Gentile, with whom many of Alan's scientific colleagues have also become affectionate friends. He is survived by Gayl, three daughters and a son from his first marriage, and nine grandchildren.

Andrew Holmes

Andrew Holmes is at the Bio21 Institute, University of Melbourne, Building 102, 30 Flemington Road, Parkville, Victoria 3010, Australia.
e-mail: aholmes@unimelb.edu.au