Helium: it's no light matter

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When it comes to cool elements, helium is truly in its element. Helium has the lowest boiling point of all elements and is, literally, a cornerstone of the Periodic Table. Helium is also one of the three 'birth elements' created right after the Big Bang.

As a computational chemist with an interest in the history of science, I formed a strong bond with this noble element during my undergraduate studies. Helium is the smallest atom involving two-electron interactions, and therefore played a pivotal role in the early days of quantum mechanics. The successful application of the new theory to the ground state of helium was one of the early tests quantum mechanics had to pass. During 1928–30, physicist Egil Hylleraas developed the so-called 'explicit correlation' approach for solving the Schrödinger equation.[1] Using this technique, he calculated the ionization potential of helium with unprecedented accuracy. This was seen as a great triumph for the emerging theory.[2] Today, helium compounds continue to play an important role in computational chemistry as important model systems for studying weak non-covalent interactions.[3,4]

The fascinating story of helium's discovery began with the search for extraterrestrial elements. In August 1868, astronomer Pierre Janssen was waiting in Guntur India for a total solar eclipse. He hoped that this would provide an opportunity to discover new elements hidden by the sheer intensity of the sun. Janssen's spectrophotometer revealed the bright-yellow spectral line of an element never seen before. Two months later, astronomer Norman Lockyer – founding editor of the journal *Nature* – detected the same elemental signature in the sun's corona. He baptized the new element 'Helium' – after the Greek Sun God Helios.

For over a decade, it was believed that this elusive element existed only on the sun. However, in 1882, Luigi Palmeri discovered terrestrial helium in lava ashes harvested from Mount Vesuvius in Naples. In 1895, William Ramsay isolated helium and in 1904 he was awarded the chemistry Nobel Prize for the discovery of the entire family of noble airs.

The race to liquefy helium began shortly thereafter. It unfolded as a battle between two giants: James Dewar (the first to liquefy hydrogen), and Heike Onnes (who discovered superconductivity). The battle was finally decided in the summer of 1908 when Onnes liquefied helium at –268.9 ºC, reaching closer than ever to absolute zero. This monumental achievement won Onnes the 1913 Nobel Prize.

Liquid helium is a crucial agent for cooling the superconducting magnets of MRI and NMR machines, and the supercolliders in CERN's Large Hadron Collider. The space industry uses helium to pressurize rockets and in sensitive satellite equipment. In high-tech industries, silicon and germanium crystals are grown under helium's inert atmosphere.

Although helium is the second most abundant element in the universe, at a global human consumption rate of about 80 tons a day, it is expected to disappear from the face of the planet within a few decades.[5] This poses a potential threat not only to research but also to medical diagnosis procedures such as MRI scans.

References

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