Dutch chemists make new chiral palladium metal

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Researchers at the University of Amsterdam (UvA) have succeeded in making the first ever piece of chiral palladium metal. The findings, by a research team led by Gadi Rothenberg, professor of Heterogeneous Catalysis and Sustainable Chemistry at the UvA, are significant because they lead to an entirely new class of materials. These are metallo-organics - they combine the variety of organic molecules with the special properties of metals. The research results are published this week in *Nature Chemistry*.

Chirality is a Greek term that means that an object, for example a molecule, has a mirror image, such as two hands. Chiral molecules have asymmetrical centres or right- or left-handed structures. Metals are not chiral because they have neither. However, in the UvA experiments, palladium metal could be made chiral by using organic template molecules which were then later removed.

These new materials, metallo-organics, are the opposite of organometallics. The possibilities of imprinting metals with organic molecules are practically endless, and the process itself is so simple that it can be used in high-school demonstration experiments.

Using simple precipitation technology, Prof. Rothenberg and Dr Laura Duran Pachon managed to imprint palladium metal crystals with a chiral organic template. The entire template was then removed, leaving a chiral cavity in the palladium metal. The metal itself retains all its usual properties, such as malleability, conductivity, and catalytic activity.

Using a ten-tonne French press, the researchers even pressed a chiral palladium coin, roughly the size of a two-cent piece.

The chirality of the metal was proven in various experiments carried out in collaboration with the group of professor Ron Naaman at the Weizmann Institute of Science in Rehovot, Israel. Like all metals, palladium exhibits the photo-electric effect: when a high-energy photon hits the metal, an electron is ejected. However, PhD student Tal Markus in Rehovot showed that the palladium coin made in Amsterdam ejected different electrons when exposed to clockwise polarized or anticlockwise polarized photons, proving the metal's chirality.

Another experiment demonstrated differences in absorption reactions in the two chiral metals. Together with PhD student Itzik Yosef and professor David Avnir of the Hebrew University of Jerusalem, the catalytic activity of the adapted metals was displayed.

More information: L. Durán Pachón, I. Yosef, T.Z. Markus, R. Naaman, D. Avnir, G. Rothenberg: 'Chiral imprinting of palladium with cinchona alkaloids'. Nature Chemistry, 20 April 2009.

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