Researchers report upside-down magnesium chemistry discovery

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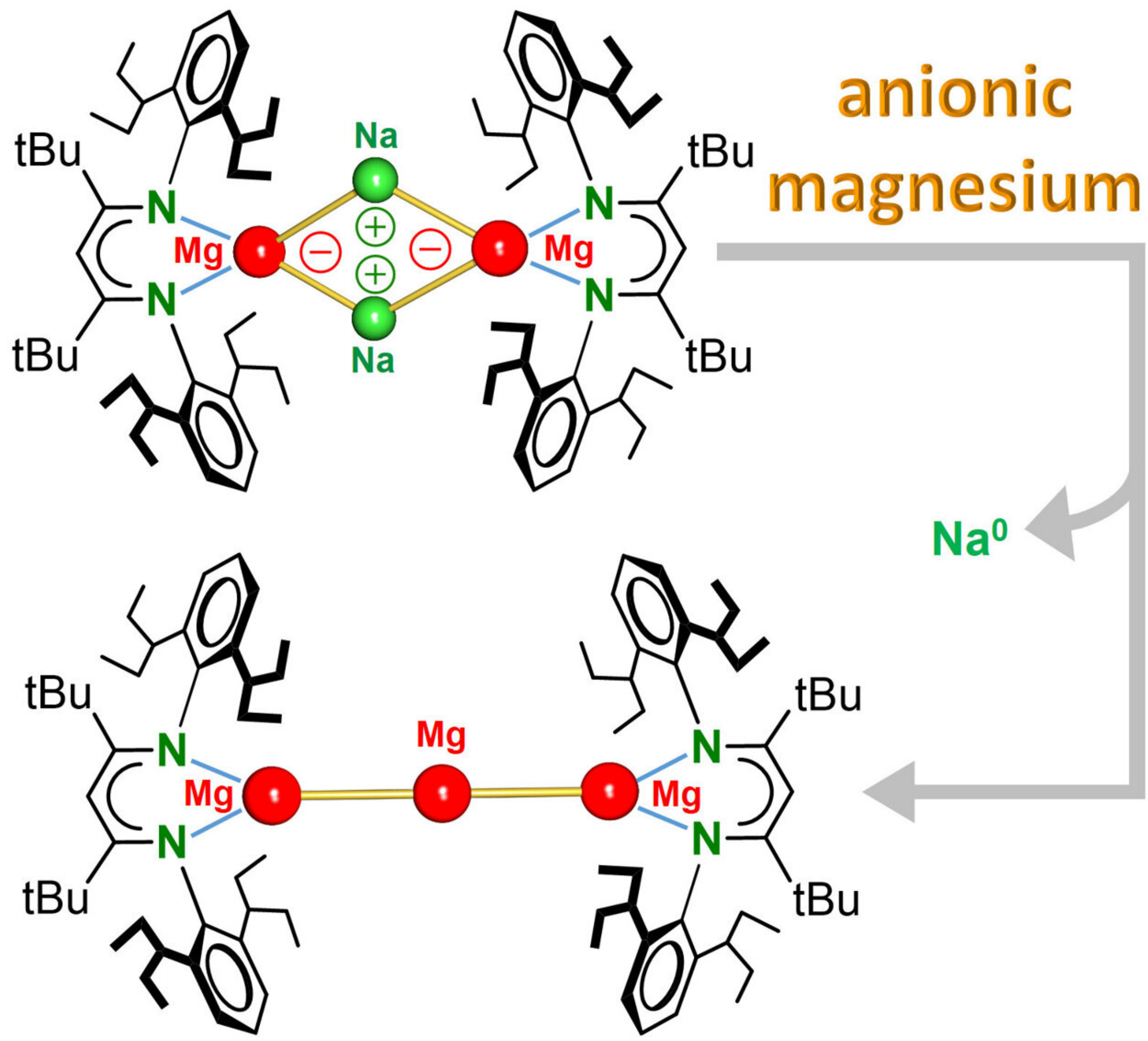

Image: Harder Group

Chemists at the Friedrich-Alexander-University Erlangen-Nürnberg have published a breakthrough in magnesium chemistry in the journal *Nature*.

Magnesium (Mg) is an earth-abundant early main group metal of low electronegativity that easily loses its valence electrons. In combination with other elements, it occurs naturally only in its most stable form as the positively charged Mg^{2+} cation. The Mg^{2+} cation is found in various minerals but also in chlorophyll, the pigment that makes plants green. Magnesium in the abnormal oxidation state +I was first detected in interstellar clouds, but recently, first complexes with Mg^{+} have been isolated.

The team around Prof. Sjoerd Harder (Chair of Inorganic and Organometallic Chemistry) now reports the discovery of the first Mg^{0} complexes in which the metal has an oxidation state of zero and is even negatively charged. These complexes, which contain unique magnesium-sodium bonding (Mg–Na), react completely differently than common Mg^{2+} compounds. While electron-poor Mg^{2+} cations can accept electrons, the electron-rich anionic Mg^{0} center reacts by donating electrons.

The complex is soluble in common organic solvents and is an extremely strong reducing agent: Slight heating led to immediate reduction of the Na^{+} cations to Na^{0}, a metal that normally has a strong tendency to oxidize to Na^{+} cations. During this thermal decomposition, a new type of complex is formed in which three Mg atoms connect like beads in a chain. This Mg^{3} cluster reacts like atomic Mg^{0} and could be seen as the smallest piece of Mg metal, which is soluble in organic solvents. This new class of anionic Mg complexes turns Mg chemistry completely upside down. Further unusual reactivity of this soluble, extremely strong, reducing agent can be expected.

More information: B. Rösch et al. Strongly reducing magnesium(0) complexes, *Nature* (2021). DOI: 10.1038/s41586-021-03401-w

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