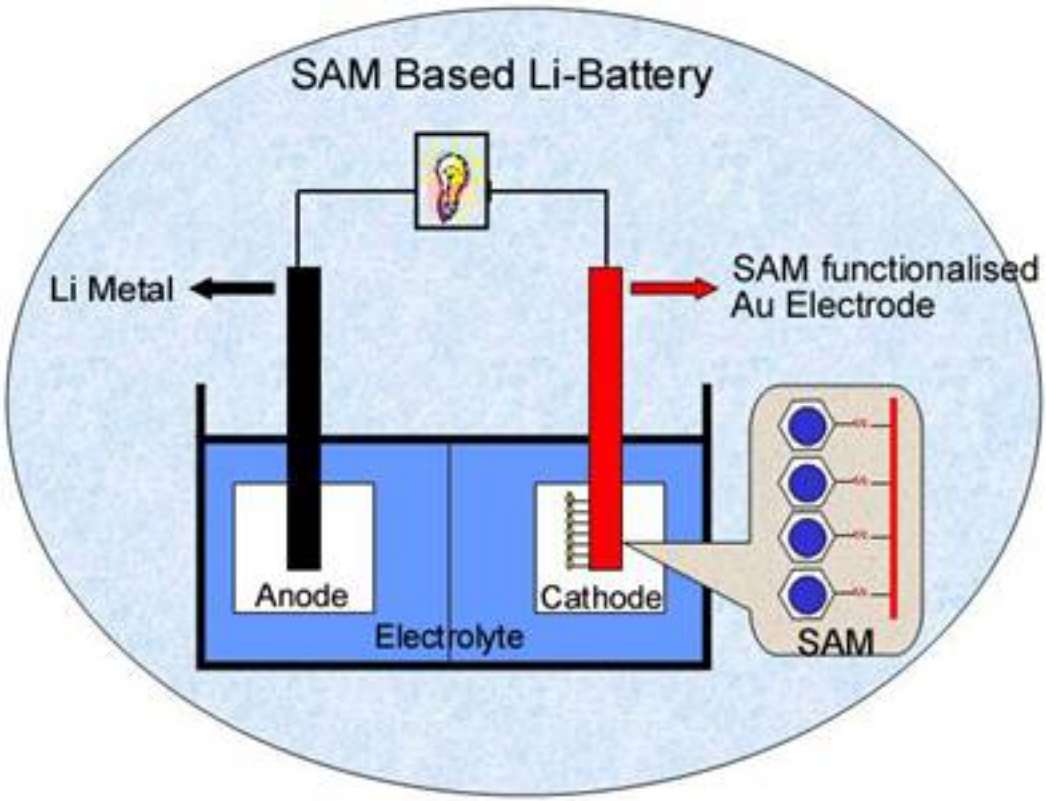
Monolayer Cathodes for Lithium Batteries

A team of scientists at NCL has demonstrated that a cathode prepared from a single layer of molecules can be used for high-energy rechargeable lithium batteries. This could result in significant weight reduction for portable batteries. Lithium batteries are used to power several electronic devices such as laptop computers, mobile phones, electric vehicles and medical devices that are implanted in human beings due to the fact that they are small, lightweight and have a long operational life. Batteries consist of two electrodes, a cathode and an anode between which current flows by conversion of chemical energy to electrical energy. The weight of batteries is primarily due to the electrodes and the chemicals used in the reactions that generate electrical power. One of the main challenges in battery technology today is to reduce the weight of the battery while using inexpensive and environment friendly materials.

NCL scientist, Dr. Vijayamohanan and his group have recently shown for the first time that a self-assembled *mono*-layer of an organic molecule (a disulphide) can be used to prepare cathodes. Self-assembled monolayers (SAMs) are closely packed arrays of organic molecules. SAMs are easily prepared and are very stable. Scientists have been able to prepare SAMs with different properties (such as their wettability or stickiness) using a variety of organic molecules. However, the molecules used to prepare SAMs are normally insulating, viz. they do not conduct electric current, and therefore, could not be



used previously for battery applications.

Dr. Vijayamohanan's strategy involved preparation of a SAM on a metal using a disulphide, an organic molecule with sticky sulphur atoms attached on each end. Disulphide is stuck on gold to create a single well-ordered monolayer and this forms the cathode. The disulphide molecule allows lithium ions in solution to effectively hook-up with the cathode and establishes a flow of current through the external circuit. The SAM-coated gold was used along with a lithium electrode (and other lithium salts and specific solvents and co-solvents) to prepare a lithium battery that gave an open circuit voltage of 2.9 V. This monolayer-based electrode represents a significant innovation that could lead to weight reduction of the active cathode component resulting in light portable batteries for miniaturized electronics applications.

U.S. Pat. Appln. Publ., 20030186123 Process for the preparation of cathode materials, cathode materials prepared thereby and batteries containing said cathode materials, Maddanimath, Trupti; Khollam, Yogesh Baban; Mulla, Imtiaz; Vijayamohanan, Kunjukrishana Pillai.

Trupti Maddanimath, Yogesh B. Khollam, M. Aslam, I.S. Mulla, K. Vijayamohanan, *Journal of Power Sources*, **124** (2003) 133–142.

For more information please contact Dr. K. Vijayamohanan

To see the list of all R&D features, click here