

## THE NOBEL PRIZE IN CHEMISTRY 2019



**John B. Goodenough**  
 (Born: 1922, Jena, Germany)  
 Affiliation at the time  
 of the award: University  
 of Texas, Austin, USA



**M. Stanley Whittingham**  
 (Born: 1941, United Kingdom)  
 Affiliation at the time of the  
 award: Binghamton Univer-  
 sity, State University of New  
 York, New York, USA



**Akira Yoshino**  
 (Born: 1948, Suita, Japan)  
 Affiliation at the time of the  
 award: Asahi Kasei Corpo-  
 ration, Tokyo, Japan, Meijo  
 University, Nagoya, Japan

The Nobel Prize in Chemistry 2019 was awarded jointly to **John B. Goodenough**, **M. Stanley Whittingham** and **Akira Yoshino** “for the development of lithium-ion batteries”. This lightweight, rechargeable and powerful battery is now used in everything from mobile phones to laptops and electric vehicles. It can also store significant amounts of energy from solar and wind power, making possible a fossil fuel-free society.

The foundation of the lithium-ion battery was laid during the oil crisis in the 1970s. **Stanley Whittingham** worked on developing methods that could lead to fossil fuel-free energy technologies. He discovered an extremely energy-rich material, which he used to create an innovative cathode in a lithium battery. **John Goodenough** predicted that the cathode would have even greater potential if it was made using a metal oxide instead of a metal sulphide. In 1980 he demonstrated that cobalt oxide with intercalated lithium ions can produce as much as four volts.

This was an important breakthrough and would lead to much more powerful batteries.

With Goodenough’s cathode as a basis, **Akira Yoshino** created the first commercially viable lithium-ion battery in 1985. Rather than using reactive lithium in the anode, he used petroleum coke, a carbon material that, like the cathode’s cobalt oxide, can intercalate lithium ions.

The result was a lightweight, hardwearing battery that could be charged hundreds of times before its performance deteriorated. The advantage of lithium-ion batteries is that they are not based upon chemical reactions that break down the electrodes, but upon lithium ions flowing back and forth between the anode and cathode.

Lithium-ion batteries have revolutionised our lives since they first entered the market in 1991. They have laid the foundation of a wireless, fossil fuel-free society, and are of the greatest benefit to humankind.