



## Khalil Amine (USA)

**“For outstanding contribution into the development of the efficient electrical energy storage technology”**

Born on December 1, in 1962 in Morocco

### **Background**

- In 1986, he graduated from University of Bordeaux (France) with a master’s degree in material sciences. Three years later, he received a doctorate in materials science from the National Center for Scientific Research in Bordeaux (CNRS).
  - In 1990-1992, he underwent postdoctoral studies in the Laboratory of Physical Chemistry and Physics of Materials of the Catholic University of Leuven, Belgium, and the Industrial Chemistry Department of Kyoto University in Japan.
  - From 1992 to 1998, he worked as a group leader at the National Research Institute of Osaka, and at the Laboratory of Fundamental Technologies of the Corporate Research Center of Japan Storage Battery Company in Kyoto, Japan.
  - From 1998 till present, Khalil Amine is an Argonne Distinguished Fellow and the Manager of the Advanced Lithium Battery Technology Group at Argonne National Laboratory where he is responsible for research and development of advanced materials and battery systems for electric vehicles, power supply, and satellites, military and medical applications.
  - Since 2015, the scientist holds an adjunct professor position at Stanford University, and others and has been cooperating with many universities all over the world: Austria, Germany, Hong Kong, China, Korea, Saudi Arabia, USA, France, Chile, Morocco, Spain, Canada and other countries.
  - Dr. Amine is a member of the Council for Car Fuel Economy of the National Research Council at the US Academy of Sciences; full-fledged member of the Electrochemical Society and the Materials Research Society; member of the American Chemical Society and of the American Ceramic Society; Chairman of the International Association of Lithium Automotive Batteries; President of the international meeting on lithium ion battery association (IMLB), Chairman of the Supervisory Committee for the Implementation of the Japan-European Union Energy Conservation Research Initiative; organizer of many major thematic international conferences and seminars.
  - Dr. Amine is a recipient of dozens of prestigious engineering and scientific awards and prizes. Among his many awards, there is the prize of the Electrochemical Society for his contribution to the development of battery technology, NAATBatt for lifetime scientific achievements, five R&D100 (2005, 2008, 2009, 2012, 2014) which is considered the Oscar of technology and innovation, International Battery association award, FMC award for outstanding research in
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batteries for electric vehicles, Scientific America's Top 50 award, US-DOE vehicle technology office award for outstanding scientific achievement, University of Chicago distinguished scientist award, Elsevier distinguished scientist award on energy storage, International coalition of Energy Storage and Innovation award etc.

### **Scientific Achievements**

- Khalil Amine worked on new cathodes and anodes for lithium-ion batteries, participated in the development of new liquid-polymer electrolyte systems, lithium-oxygen, lithium-sulfur, sodium-ion batteries and in other studies. He stood at the origins of  $\text{LiNi}_{0.5}\text{Mn}_{1.5}\text{O}_4$  5-volt spinel cathode, which is being now actively and internationally introduced into power systems.
- NMC cathode is considered to be the scientist's major accomplishment. At present, it is widely used in household electric appliances and in electric vehicles such as Chevy Volt, Chevy Bolt, Nissan Leaf, Fiat Chrysler, BMW I3 and I8, Ford, Toyota, Honda and Hyundai.
- He invented an innovative cathode where every particle has a complex structure, which increases its productivity and stability under high voltage. The cathode was called a "full-gradient concentration cathode", and after the publication in Nature Material in 2012, it was licensed by several large enterprises producing batteries and cars. This cathode will be the cathode of choice for the next generation lithium ion battery for automotive and smart grid application.
- He invented new electrolyte additives for cathode and anode passivation significantly extending the life cycle of lithium-ion accumulator batteries.
- Dr. Amine's list of publications is amazingly long. The scientist is a world champion in publications about accumulator batteries. According to *ScienceWatch* analytical portal, he published 544 scientific articles in the years 2000 till 2018.
- He is the most cited scientist in the world on the topic of accumulator batteries. His works were cited 43789 times by various sources, which is indicative of the fact that his research is exceptionally important. According to Clarivate.com, he is the world's most cited scientist of the decade in the sphere of energy storage elements. His citation index is 112.
- He holds or has filed 197 patents and inventions. 102 patents were issued and 33 patent applications have been published in the USA; 30 patents were issued and 22 applications undergo the publication study in Japan.

### **Highlights**

- The anodes, cathodes, electrolytes and technologies designed by the scientist are used by many corporations all over the world, such as BASF, LG Chemical, General Motors, Envia, Microvast, Samsung, TODA and Umicore.
- Not so long ago, Dr. Amine developed a new superoxide battery system capable to yield up to five times more energy than lithium-ion batteries. This discovery was described in Nature Journal and gave impetus to a new round of research aimed at increasing the energy density of batteries and reducing costs, which should lead to a sharp increase in the number of electric vehicles in the future.
- The scientist is a reviewer of several nationwide projects in Japan, France, Germany, Australia, Poland, New Zealand and the USA aimed at the development of efficient new-generation batteries and at the implementation of power-saving programs.
- Dr. Amine is a columnist of numerous scientific and popular science journals all over the world.
- The scientist's innovations have found their use in electric vehicles, smart grids and domestic electric appliances.