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Retraction

Retracted: A Certain Investigation of Nanomaterial-Based Li-Ion Batteries for Electrical Vehicles

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] M. Sivaramkrishnan, R. Agenya, A. S. M. Antony et al., "A Certain Investigation of Nanomaterial-Based Li-Ion Batteries for Electrical Vehicles," *Journal of Nanomaterials*, vol. 2022, Article ID 2700050, 6 pages, 2022.

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Research Article

A Certain Investigation of Nanomaterial-Based Li-Ion Batteries for Electrical Vehicles

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Nowadays, the transports vehicles are required improvement or alternative source for fuel requirement, because of fuel shortage and reducing the global warming. Due to this reason, the electrical vehicle is more concentrated now. The electrical vehicle reduces the carbon emission and reduces the global warming. The main drawback for electrical vehicle is charging time and battery size. To overcome this problem, we use nanomaterial using batteries (like Li-ion battery and Li-based batteries). The nanomaterial particles increase the performance and storage battery capacity and reduce the size of the batteries.

1. Introduction

The term "nanomaterials" refers to substances with an outer diameter of at least one nanometer. According to the European Commission's definition, at least half of the debris within the broad variety length distribution must have particle lengths of 100 nm or less.

Nanomaterials may form spontaneously, be synthesised via the use of fuel combustion processes, or be engineered to perform a specific task. Their physical and chemical properties may be distinct from those of their bulk-shape cousins. [1].

2. Usage of Nanomaterials

Many sectors, from health products and beauty to protection of environment and air purification, use nanomaterials because of their ability to synthesize compounds specifically for a certain role [2]. Below is an illustration of the function of nanomaterials.

For example, nanoparticles are widely used in the healthcare industry for a variety of purposes, the most important of which is medication delivery [3]. To tackle cardiovascular disease, researchers are using nanoparticles to

speed up the delivery of chemotherapy tablets to malignant growths and to deliver medicines to areas of arteries that may have been damaged [4]. To create microbe sensors, carbon nanotubes are being improved for use in processes in which antibodies are added to the nanotubes as shown in Figure 1.

Carbon nanotubes might be used in the aerospace sector to morph aircraft wings. An electric voltage causes the nanotubes to bend in reaction to the voltage [5].

There are many other applications for nanoparticles in environmental protection, such as the use of nanowires. The zno nanowire (zinc oxide nanofibers) is being developed for use in flexible solar panels and in the treatment of dirty water.

There are several examples of nanoparticles and the sectors in which they are used. Titanium oxide nanoparticles are employed in sun block inside the cosmetics sector because of the poor lengthy balance that chemical UV protection gives. With their nano-shaped particles like most fabrics, titanium oxide nanoparticles are able to provide better UV protection without whitening the skin, which may be an unwelcome side effect of sun protection. [6]. Using carbon nanotubes in the manufacturing process, the sports equipment manufacturer has created lighter and more efficient baseball bats.

Another use for nanoparticles in this industry is antimicrobial nanomaterials, which is used in items like towel and mats used by athletes to prevent microorganism-related illnesses. Military applications for nanomaterials are also being explored [8]. Cell pigment nanoparticles, for example, may be injected into the fabric of soldiers' uniforms to improve their camouflage. Better sensing systems based on nanoparticles including such titanium dioxide have been developed by the navy [7].

In addition to its application in coatings, nanotitanium dioxide may be found in self-cleaning plastic lawn chairs. Coating produces a water-sealed film that dissolves dust. The film is then removed, as well as the chairs are virtually smoothed [9].

3. Advantages of Nanomaterials

Nanomaterials' structures, in particular their length, provide unique advantages over the majority shape of substances, and their adaptability in terms of their ability to be tailored to specific needs enhances their use. An additional advantage is their high porosity, which will raise demand in a wide range of sectors.

There are several advantages to using nanomaterials, such as making current methods of generating and storing power more environmentally and economically friendly (such as solar panels) and creating new ways to both capture and store power [10].

Some of the advantages of nanomaterials will also be introduced into the electronics and computer industry [11]. With their help, digital circuit creation will become more precise at the atomic level, which will help advance a wide range of digital products.

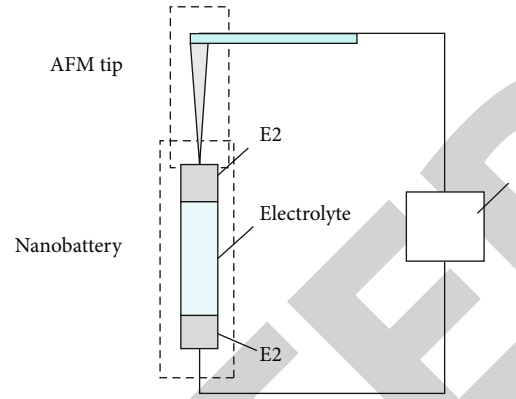

Figure 1: Function of nanomaterial.

Nanomaterials have a large surface-to-quantity ratio, which facilitates the interaction of cells and energetic elements in the scientific area. As a result, there seems to be an increase in the likelihood of successfully battling a wide range of illnesses.

4. Electrical Vehicle

An electric powered automobile (EV), additionally called an electric powered force automobile, is an automobile which makes use of one or greater electric powered vehicles for propulsion [12]. Depending at the form of automobile, movement can be furnished with the aid of using wheels or propellers pushed with the aid of using rotary vehicles, or withinside the case of tracked automobiles, with the aid of using linear vehicles. Electric automobiles can consist of electric powered cars, electric powered trains, electric powered trucks, electric powered lorries, electric powered airplanes, electric powered boats, electric powered bikes and scooters, and electric powered spacecraft.

It is a vehicle that uses electric cars and speed control for propulsion instead of more commonplace methods like the internal combustion engine, which are more widely used (ICE) [13]. Fuel for battery-powered electric vehicles is available in the form of energy (EVs). Electric vehicles (EVs) store their energy in a battery-powered garage mechanism [14]. An electric-powered engine drives the automobile's wheels [15]. Because of their limited storage capacity, electric vehicles must be recharged using an electrical source.

Cars driven by electricity differ significantly from those fueled by fossil fuels in that they may get their energy from a wide range of sources including fossil fuels, nuclear power, and renewable sources such as tidal power, solar power, and wind power [16]. To get the energy to your car, you may utilize overhead power lines, a Wi-Fi electricity switch with wireless charging, or an electrical cable that connects right away. An automobile's batteries, flywheel, super capacitor, or fuel cell may also be used to store excess energy.

Vehicles powered by internal combustion engines, on the other hand, often use undeniable, nonrenewable fossil fuels to generate their energy. The ability of electric and hybrid vehicles to recover energy during braking and send it back to the grid or the on-board battery is a major advantage

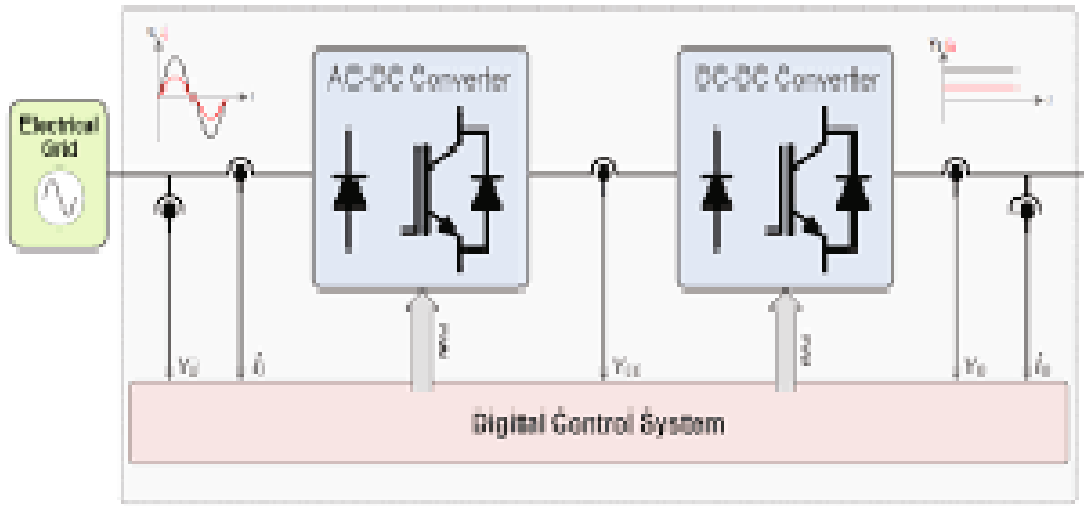

Figure 2: Charging system for electrical vehicle.

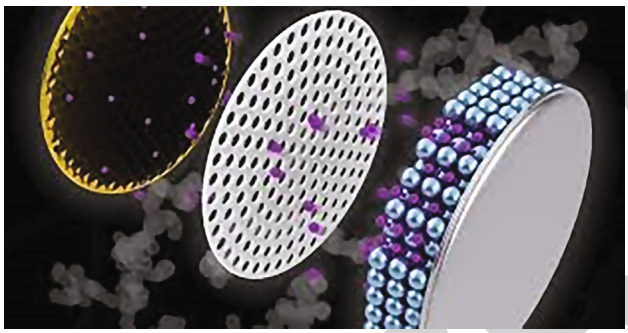

Figure 3: Nanoparticles in batteries.

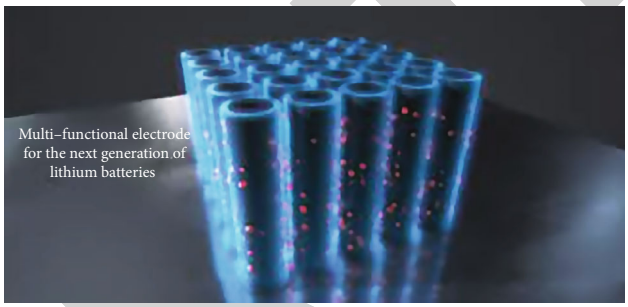

Figure 4: Nanotechnology used in batteries.

of these vehicles (V2G) [17]. A fresh interest in an electric transportation infrastructure was sparked by environmental concerns at the beginning of the twenty-first century, along with the specter of rising oil prices. As a result, hybrid electric driven automobiles and natural and/or electric cars, which may be fueled by renewable energy, are becoming more popular.

Emissions from electric cars are completely eliminated since there are no tailpipe emissions. Vehicle greenhouse gas emissions reductions are dependent on the source of the energy used to power the vehicle [18]. The use of an electric vehicle might reduce carbon dioxide emissions by 30 percent if the U.S. electrical mix is used. Modern energy mixes in various nations suggest that certain emissions might be reduced by 40 percent in the UK, by 19 percent in China, and by as little as 1 percent in Germany, depending on the country.

Electric vehicles are usually powered via way of means of on-board battery packs and as such are battery electric powered cars (BEVs). However, due to the battery's inadequate power capacity when compared to fossil fuels, electric vehicles have extremely negative range between charges and recharging can take a considerable amount of time, despite their consistent ability to just provide exact kinetic energy and attribute usually suitable maximum speed. However, for ordinary use, as opposed to lengthy journeys, electric powered vehicles are very realistic kinds of transportation and may be inexpensively recharged overnight. Other on-board electricity garage techniques which can provide greater variety or quicker recharge are regions of research as in Figure 2.

Electric vehicles are predicted to purpose a revolution withinside the vehicle mobile enterprise given blessings in metropolis pollutants, much less dependence on overseas oil imports, and predicted upward push in fuel prices.

Electric vehicles are a lot of electric powered automobile (EV); the term "electric powered automobile" refers to any automobile that makes use of electric powered cars for propulsion, while "electric powered vehicle" usually refers to street-going vehicles powered via way of means of energy [19]. While an electric powered vehicle's energy supply is not always explicitly an on-board battery, electric powered vehicles with cars powered via way of means of different electricity reasserts are usually mentioned via way of means of an extraordinary name: An electric powered vehicle powered via way of means of daylight is a sun vehicle, and an electric powered vehicle powered via way of means of a fuel generator is a shape of hybrid vehicle [20]. Thus, an electric powered vehicle that derives its energy from an on-board battery percent is referred to as a battery electric powered automobile (BEV). Most regularly, the term "electric

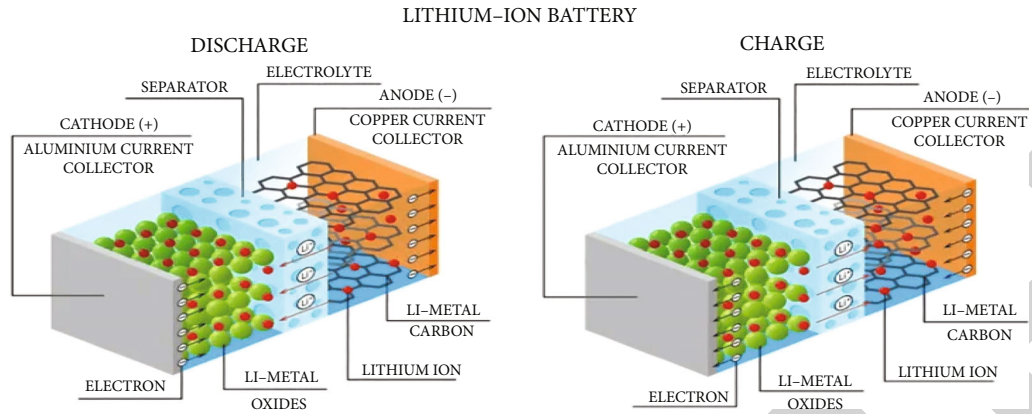

Figure 5: Nanometals in Li-ion batteries.

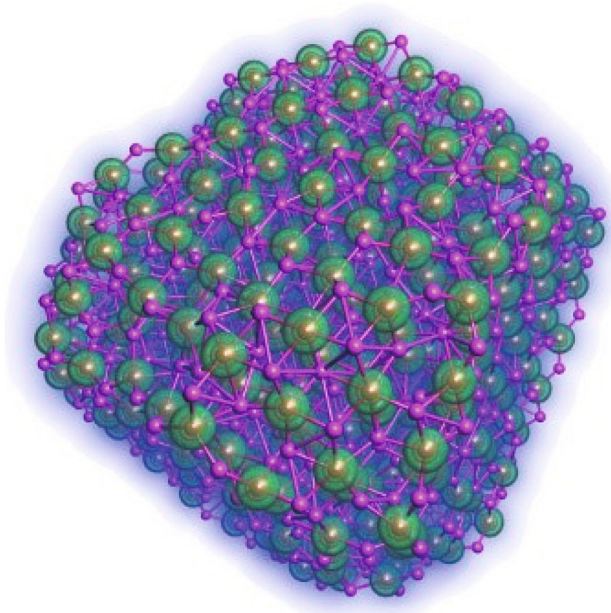

Figure 6: Structure in nanomaterials.

powered vehicle" is used to consult natural battery electric powered cars, inclusive of the REVA and GM EV1.

In an electric powered automobile (EV), a battery or different electricity garage tool is used to keep the energy that powers the motor. EV batteries need to be replenished via way of means of plugging withinside the automobile to an energy supply [21]. Some electric powered cars have onboard chargers; others plug right into a charger positioned out of doors the automobile. Both types, however, use energy that comes from the energy grid. Although energy manufacturing might also additionally make a contribution to air pollutants, EVs are taken into consideration 0-emission cars due to the fact that their cars produce no exhaust or emissions.

There are presently no mild-responsibility electric powered cars to be had from the principal auto mobile manufacturers. Neighborhood electric vehicle (NEVs), on the opposite hand, are being synthetic via way of means of a lot of companies. These small cars are usually used for community commuting, mild hauling, and delivery [22]. Their use is restricted to regions with 35 mph velocity limits or for off-street carrier on university campus or at airports or hotel regions.

Because they are restricted to speeds of 25 mpg or much less, NEVs are not taken into consideration mild-responsibility cars and are not eligible for fleet credit score below the Energy Policy Act of 1992 Standard Compliance alternative and Federal Fleet Requirements. However, their versatility in transferring human beings thru restricted shuttle regions makes them beneficial in a lot of programs. Other beneficial EVs in area of interest programs encompass electric powered scooters and bike [23].

5. Nanotechnology in Electric Vehicle Batteries

When compared to a traditional gasoline engine, EVs utilize less energy to move. Switching from oil to renewable and environmentally friendly sources of energy may be possible via a shift in the car sector [24].

When compared to nickel metal hydride batteries, lithium-ion batteries have the following benefits. Modern variants employ lithium-ion batteries, which have a number of benefits over nickel metal hydride batteries.

Electric automobiles, on the other hand, have too many drawbacks to be a viable alternative to conventional vehicles [25]. Long-distance travel needs more power and a longer recharge period. We could enhance lithium battery chargers using nanotechnology. Better battery performance may be achieved through the use of nanomaterials or nanocomposite material in the formulation of electrolytes.

As shown in Figure 3, a more improved battery, made possible by nanotechnology, may hold the key. Nanoparticles and nanocomposite electrolytes have been found to enhance current electric car qualities and lithium battery performance.

6. Current State of Electric Vehicle Technology

As a result, producers must focus on reducing the cost, increasing the capacity and longevity of batteries, and

Table 1: Comparison table for normal Li-ion battery and nanomaterial battery.

S.no	Li-ion battery Drawback	Nanomaterial battery Advantage
1	The battery cannot be charged at temperature earlier than 32-degree farad. Due to the formation of strong electrolyte interface barrier	Electrode is made from nanomaterial. Result: No formation of stable electrolyte interface barrier
2	The batteries are gradual to rate and discharge. Due to the lengthy distance Li-ion should travel via the electrode material withinside the battery. Speed at which the Li-ion make their manner via the electrode material is likewise gradual	Electrode particles are non-structured. Result: (1) Shortens the present distance with withinside the electrode material. (2) Accelerates the recharging and discharging rate

improving quality in order to make electric cars more efficient. [26].

Nanotechnology is being hailed as a game changer by a number of businesses. Ford Motor Company, for example, is investigating how it may employ these new technologies to make lighter automobiles, which will lower the amount of effort consumed to power each vehicle.

7. Nanotechnology in Batteries

Lithium-ion batteries' performance has suffered in the past when graphite powder has been utilized as an intercalation material. Nanotechnology can help in the creation of more efficient battery technologies.

Materials such as carbon nanotubes can make it easy to change the capacity of lithium-ion batteries. As shown in Figure 4, they can bind higher concentrations of lithium and help the battery produce more power. [27]. Carbon nanotubes are also useful because they have a large surface area that makes them perfect for batteries. Titanium dioxide and vanadium oxide, used in wires at the negative electrode, are two materials that represent promising fresh options for these batteries.

Development of new electrode materials is still in the early stages—any fundamental change to this colossal industry like the automotive industry has to be ready for such high levels of manufacturing [28]. The commercial oxide materials now on the market may be able to assist, but they are either prohibitively costly or have safety concerns. They include Li (NiNiCoAl)O2, Li (NiMnCo)O2, and Li (AlMn2O4), as well as a few others, such as LiCo2O4. The creations' nanostructuring has improved significantly.

With new advancements in technology, lithium ions can travel more efficiently. Materials like nanowire, nanoparticles, and nanotubes are being examined as both positive and negative electrode materials [29].

In order to make batteries both cost-effective and lightweight, researchers are trying out new electrode compositions [30]. They do this by changing aspects such as morphology and surface area as in Figure 5.

8. Nanoenhanced Batteries for Electric Vehicles

The EPA performed research on the lifecycle of some current battery technologies to make electric vehicles, as well as a next generation battery component that would use SWCNT technology as in Figure 6.

The team conducted a quantitative environmental LCA and examined the intake of battery manufacturers specifically.

This study is needed to ensure that environmental and health risks are mitigated across the industry [31]. It will contribute to developing a battery that is eco-friendly and efficient, by examining the impact of different materials on life-cycle impacts.

Research teams are focusing on improving car chargings. Unlike other cells, this technology can charge a car 30× faster.

The new battery technology allows participants to charge in just one minute [32]. The team obtained a high density of carbonized secondary particles from sucrose-coated cluster nanoparticles, then when heated up to 600 degrees Celsius, and cured the particles so that they all participate in the process of quick charging. Table 1 represents the comparison Li-ion and nanomaterial battery.

9. Conclusion

Now, the nanomaterial batteries are in research process for further improvement, for example, increasing the battery capacity and reducing the charging time period of the batteries are very useful for long distance travel using electrical vehicle. Due to battery capacity and charging time, the fossil fuel is preferred in long distance's improving battery performance. Nanomaterial is one of the good choices.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

[1] K. I. Ozoemena and S. Chen, *Nanomaterials in advanced batteries and supercapacitors*, Springer Cham, 2016.

[2] Y. Abu-Lebdeh and I. Davidson, *Nanotechnology for lithium ion battery*, Springer New York, NY, 2013.

[3] S. Dhameja, *Electric vehicle battery systems*, Elsevier B.V, 2022.

[4] P. Nelson, K. Amine, A. Rousseau, and H. Yomoto, Eds., "Advanced lithium-ion batteries for plug-in hybrid-electric vehicles," in *Proceedings from the 23rd Electric Vehicle*

Symposium, pp. 1–18, 2007, http://www.transportation.anl.gov/pdfs/HV/461.

[5] M. Yoshio, R. J. Brodd, and A. Kozawa, Eds., *Lithium-ion batteries science and technologies*Springer International Publication.

[6] B. Scrosati, J. Garche, and W. Tillmetz, Eds., *Advances in battery technologies for electric vehicles*.

[7] J. Jiang and C. Zhang, Eds., *Fundamentals and application of lithium-ion batteries in electric drive vehicle*.

[8] B. Frieske, M. Kloetzke, and F. Mauser, "Trends in vehicle concept and key technology development for hybrid and battery electric Vehicles," *World Electric Vehicle Journal*, vol. 6, no. 1, pp. 9–20, 2013.

[9] T. J. Wallington, E. Alonso, M. P. Everson et al., *Sustainable mobility lithium, rare earth elements, and electric vehicles*, Springer, Berlin, Heidelberg, 2013.

[10] M. Gaberšček, "Lithium Batteries. advanced technologies and Applications. Herausgegeben von Bruno Scrosati, K. M. Abraham, Walter Van Schalkwijk und Jusef Hassoun," *Angewandte Chemie*, vol. 126, no. 21, pp. 5342-5343, 2014.

[11] J. B. Goodenough and K.-S. Park, "The Li-ion rechargeable battery: a perspective," *Journal of the American Chemical Society*, vol. 135, no. 4, pp. 1167–1176, 2013.

[12] P. G. Bruce, S. A. Freunberger, L. J. Hardwick, and J.-M. Tarascon, "Li-O_2 and Li-S batteries with high energy storage," *Nature Materials*, vol. 11, no. 1, pp. 19–29, 2012.

[13] M. Reddy, G. Subba Rao, and B. Chowdari, "Metal oxides and oxysalts as anode materials for Li ion batteries," *Chemical Reviews*, vol. 113, no. 7, pp. 5364–5457, 2013.

[14] J. T. South, R. H. Carter, J. F. Snyder et al., "Multifunctional power-generating and energy-storing structural composites for US army applications," *Materials Research Society Symposium Proceedings*, vol. 851, pp. 139–150, 2005.

[15] J. P. Thomas and M. A. Qidwai, "Mechanical design and performance of composite multifunctional materials," *Acta Materialia*, vol. 52, no. 8, pp. 2155–2164, 2004.

[16] Z. Shi, M. Radwan, S. Kirihara, Y. Miyamoto, and Z. Jin, "Enhanced thermal conductivity of polymer composites filled with three-dimensional brushlike AlN nanowhiskers," *Applied Physics Letters*, vol. 95, no. 22, p. 224104, 2009.

[17] W. Cui, F. Du, J. Zhao et al., "Improving thermal conductivity while retaining high electrical resistivity of epoxy composites by incorporating silica-coated multi-walled carbon nanotubes," *Carbon*, vol. 49, no. 2, pp. 495–500, 2010.

[18] A. Rahman, A. Hossain, A. H. M. Zahirul Alam, and R. Mahbubur, "Fuzzy knowledge-based model for prediction of traction force of an electric golf car," *Journal of Terramechanics*, vol. 49, no. 1, pp. 13–25, 2012.

[19] A. Rahman, F. A. Razak, M. N. A. Hawlader, and M. Rashid, "Nonlinear modeling and simulation of waste energy harvesting system for hybrid engine: fuzzy logic approach," *Journal of Renewable and Sustainable Energy*, vol. 5, no. 3, pp. 1–13, 2013.

[20] 2015, http://www.mckinsey.com/.../Automotive%20and%20Assembly/.../Lightweight.

[21] A. Rahman, S. Farhan, H. Ahmed, and M. N. A. Hawlader, "Fuzzy controlled evaporative battery cooling system for EVs/HEVs," *International Journal of Electric and Hybrid Vehicles*, vol. 8, no. 2, pp. 233–240, 2014.

[22] A. Nadeem, M. N. Rafiq, M. B. Qureshi, and M. Jawad, "Joint power management of telecom exchanges and electric vehicles using hybrid AC-DC microgrid," in *2017 International Conference on Frontiers of Information Technology (FIT)*, pp. 127–132, 2017.

[23] D. R. Aryani and H. Song, "Coordination control strategy for AC/DC hybrid microgrids in stand-alone mode," *Energies*, vol. 9, no. 6, p. 469, 2016.

[24] B. Lindemark, "Technical and economic aspects when using both DC (-48 V) and AC (230 V) telecom systems," in *Proceedings of Intelec'96 - International Telecommunications Energy Conference*, pp. 588–591, 1996.

[25] L. Yu, T. Jiang, Y. Zou, and Z. Sun, "Joint energy management strategy for geo-distributed data centers and electric vehicles in smart grid environment," *IEEE Transactions on Smart Grid*, vol. 7, no. 5, pp. 2378–2392, 2016.

[26] N. Jovalekic, M. Lazic, and B. Sasic, "Hybrid backup power supply for telecommunication systems based on fuel cell," *Facta universitatis - series: Electronics and Energetics*, vol. 24, no. 1, pp. 31–39, 2011.

[27] I. Buchman, "BU-1004: Electric vehicle charging," 2017, http://batteryuniversity.com/learn/article/bu_100_4_charging_an_electric_vehicle.

[28] L. E. Erickson, J. Robinson, and G. C. Brase, *Solar Powered Charging Infrastructure for Electric Vehicles: A Sustainable Development*, CRC Press, Boca Raton, FL, USA, 2016.

[29] C. C. Azhar-Ul-Haq and E. Al-Ammar, "Modeling of a Photovoltaic-Powered electric vehicle charging station with Vehicle-to-Grid implementation," *Energies Journal*, vol. 10, no. 1, p. 4, 2017.

[30] "Overview of telecom infrastructure and power plant," 2014, http://learntelecom.bsnl.co.in/EETP_STUDY_MATERIAL_MODULE/EETPTSI/W1_Telecom_infra_PowerPlant.pdf.

[31] Emerson Network Power, "PS48600-3B/2900-Emerson Network Power," 2017, http://dtsheet.com/doc/1-404728/ps48600-3b2900-emerson-network power.

[32] S. M. Ali, M. Jawad, A. Feng Guo, B. Mehmood, J. G. Khan, and S. U. Khan, "Exact feedback linearization-based permanent magnet synchronous generator control," *International Transactions on Electrical Energy Systems*, vol. 26, no. 9, pp. 1917–1939, 2016.