

Communication

# The mythical heterosexual charge of a lithium-ion battery

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**Abstract:** In a recent review paper related to energy storage, the authors noted that, in a bid to enhance the performance of the anode of a lithium-ion battery (LIB), that a part of the mechanism involved the ability of silicon (Si) and graphene oxide to bind, and that this process was aided by the "mutual attraction of heterosexual charges" [1], a term or mechanism that was said to be derived from another paper [2]. A LIB, or any battery for that matter, does not have a bisexual, heterosexual or any sexual charge. It seems that this odd term and jargon neologism, or tortured phrase, was introduced as a result of mistranslation of an established term or jargon, "opposite charges". As such, it constitutes an error in need of correction. The wider implications for energy storage research such as LIBs, as well as for bibliometrics, are discussed.

**Keywords:** LIB; neologism; Nonsense text; Peer review; Renewable energy.

## 1. Introduction

Of common knowledge, a battery, such as a lithium-ion battery (LIB), consists of two opposite poles, an anode and a cathode. Much research is dedicated into seeking ways to improve the energy density and energy storage capacity of LIBs, and silicon (Si) has emerged as one promising element for creating a better anode [3]. It has been claimed that Si-based anodes of LIBs have an 11-fold higher energy capacity than graphite-based LIB anodes [4,5]. The ability to improve the performance of a LIB, for example via the Si-based anode, would have obvious important applications for the future of sustainable and renewable energy sources. One way to achieve this is to combine Si with heteroatom-doped graphene [6].

This Si and graphene-linked possibility was emphasized in a recent review by Li *et al.*, [7] in *Energy Storage Materials*, where the authors stated the following: "The modified Si could first assemble with graphene oxide (GO) through van der Waals interactions, which was then added to the graphite suspension dropwise for further electrostatic assembly with the help of mutual attraction of heterosexual charges". Of note is the latter part of their proposed mechanism, namely the need for "heterosexual charges" in order to achieve this goal. The reference they cited was a paper by Hu *et al.*, [2], who stated the following: "Therefore, the GO/Si suspension could be added dropwise to the G suspension for electrostatic assembly by mutual attraction of heterosexual charges." (p. 889). The source of the term "heterosexual charges" thus seems to be Hu *et al.*, [2].

## 2. The non-existence of "heterosexual charges"

There is a problem with this claim, however, namely that LIBs, or any battery for that matter, do not have multiple charges, as suggested by the prefix "hetero", and much less sexuality. Therefore, this is an erroneous term that has been to describe a non-existent object or phenomenon. Given that this is a review that has already cited this nonsense term from a 2019 paper, the greater risk is that this non-existent concept may be propagated into the future literature, through citation, especially if one considers the high profile and popularity of the journal, *Energy Storage Materials*. The [7] paper appears to have blindly cited [2] without questioning the claim of "heterosexual charges", at least according to the journal's co-editors-in-chief. The [7] and [2] papers have already been cited 22 and seven times, respectively according to the papers' websites.

Two possible explanations for the existence of this nonsensical term, or tortured phrase [8], may be the use of reverse translation software and/or text thesauruses to avoid plagiarism detection, or mistranslation of a Chinese term into its English equivalent. In these cases, this might arise if the authors used a weak or unspecific translation tool with erroneous output, or if an editing, English revision or translation company was involved, having provided poor and erroneous editorial services. Of relevance to this point, whereas the [2]

paper does not contain any acknowledgement or declaration of interests statement, the [7] paper does, neither paper indicating that any language, translation or editing service was involved. On this topic, it is important to note that it is unethical to not disclose the use of third party services, including language, translation or editing companies, in a scientific paper [9].

The corresponding authors of both papers were contacted (October 11-31, 2021) with a request for a published PDF copy of the papers, as well as queries regarding the source of this 'tortured phrase' and to appreciate if any third party service was employed. Neither authors provided a PDF file of their published paper. Only the corresponding author of Hu *et al.*, responded by email, indicating that the nonsensical neologism was entirely created by the authors, and not by any third party service, and that this term was accidentally created by an imperfect Chinese-English translation introduced by a student. The intended phrase was supposed to indicate "opposite charges". The possibility of the existence of other nonsensical neologisms in these papers was not explored, but merits additional scrutiny.

Most importantly, this nonsensical term does not exist, nor does the concept of the sexuality of a charge, either in LIBs, or in the field of electrical engineering. Consequently, this term is a factual and conceptual error. This is similar to a tortured phrase that claimed the heterosexuality of the carbon structure [11]. Ideally, all errors should be corrected [10], although it is easy to appreciate that total chaos may enshroud the scientific literature if individual errors were all to be corrected, even more so if several errors were detected at different moments in time for the same paper. However, despite the inconvenience, should such errors be left uncorrected? The answer may lie in a mix between the authors' voluntary desire to correct this (and other) errors, combined with the editors' insistence on doing so and the publisher's correction policy. Yet, if left uncorrected, the greater risk is the promulgation of this error into downstream literature, as has already occurred once from [2] to [1], and indirectly to another six papers that have cited the Hu *et al.*, [2] paper and to another 22 papers that cited the Li *et al.*, [1].

Although an earlier version of this paper, which was submitted as a letter to the editor, was desk rejected by Energy Storage Materials and within October, 2021, for being "out of scope" and due to "too many submissions" to those journals, the co-editors-in-chief of Energy Storage Materials and the corresponding author of Hu *et al.*, (2019) affirmed that errata would be published. Bibliometrically speaking, at least to some, the citation of errors could be interpreted as the reward of error, in the form of the gain of citations, as well as recognition for a non-existent term. It costs US\$31.50 and US\$53.00 to access the PDF file of the [7] and [2] papers, respectively. The sale of, or benefit derived from erroneous or fraudulent literature, is not often discussed but merits greater awareness and debate [3].

### 3. Conclusion

Finally, it is important to discuss the issue of publication of critique that may emerge during post-publication peer review. Although it is possible to critique publications on websites and blogs, or even on social media such as Twitter, these are not academically the ideal locations for debates to occur. What this case and experience revealed was the poor publishing infrastructure in place by these two journals to accommodate letters to the editor or evidence-based commentaries [11]. Considering that the overall tone and message was critical, not allowing academics to debate papers precisely in the journals where errors are detected, amplifies the culture of publishing bias, which over-emphasizes positive results at the expense of negative ones [12].

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