The lithium–sulfur (Li–S) battery is one of the most promising electrochemical systems for next-generation energy-storage applications, given the abundance of sulfur, its low toxicity, and its high theoretical specific charge of 1672 mAh g\textsuperscript{-1} sulfur\textsuperscript{-1} (often referred to as a capacity). However, the commercialization of Li–S cells is hindered by substantial challenges, including the insulating nature of sulfur and of its discharge product Li\textsubscript{2}S, preventing efficient active-material utilization, and the so-called polysulfide shuttle, leading to a loss of active material and low coulombic efficiency. Considerable improvements on the electrode and cell levels were made over the past few years, alleviating these limitations and, in turn, leading to an exponentially growing interest in Li–S batteries.\textsuperscript{1–5} From the perspective of every-day battery use, having a high rate capability is very important, and therefore rate-capability tests, in which the capacity is measured while changing the cycling rate (i.e., while changing the applied current), are often employed to complete the characterization of a battery. These tests are also widely used in the characterization of Li–S systems, to quantify the improvements brought about by various enhancements to the Li–S electrodes, electrolytes, their additives, and cells. Although it is known that Li–S cells, due to their complex chemistry, are sensitive to a wide range of parameters,\textsuperscript{7,8} the protocols used in rate-capability tests described in the literature vary significantly. A comparison of rate performances reported in publications for Li–S cells using commercially available materials\textsuperscript{9–12} is plotted in Figure 1. Despite their similar electrode composition (\textasciitilde 60 wt% sulfur, \textasciitilde 30 wt% carbon black, \textasciitilde 10 wt% binder (PEO or PVDF)), they display significantly different rate performances. This may partially be due to the significantly different discharge cutoff voltages used, and highlights the fact that the conditions used for the rate-capability tests have a significant impact on their results and should be unified to enable tracking the advances in Li–S-cell development. For example, some authors vary only the discharge rate,\textsuperscript{13–16} whereas in most other cases, both charge and discharge rates are varied. Also, not always is the number of cycles at each rate specified,\textsuperscript{10,17–20} nor is it always constant.\textsuperscript{21,22} Moreover, the rates are usually increasing with cycle number, raising questions about the influence of the slow first cycles on the polysulfide diffusion and their impact for the further performance of the cell. At the same time Li–S performance is known to be also dependent on a wide range of electrode and electrolyte parameters. The different electrode thicknesses have a strong influence on the quality of cell operation and can lead to different degrees of sulfur utilization and, consequently, to different rate capabilities.\textsuperscript{23} Other parameters, such as the amount of electrolyte or the presence of electrolyte additives, may also affect the rate performance, as they do affect the extent to which the polysulfide shuttle impacts on the performance of the cell.\textsuperscript{24,25}

The aim of the present study is to assess the sensitivity and reliability of rate-capability tests for Li–S systems. We have studied in a systematic way how various cycling conditions and electrolyte-related parameters influence the practical capacity, the coulombic efficiency, and the overpotentials in a model Li–S cell at various rates. This approach enabled us to identify the individual effects of these experimental conditions on the rate performance. This work demonstrates that determining the rate capability of a Li–S cell is not straightforward and highlights the need to standardize, beyond electrode and cell parameters,\textsuperscript{7,8} rate-capability-test protocols for a meaningful comparison of different Li–S systems.

**Experimental**

Sulfur composite electrodes were prepared by mixing 60 wt% sulfur (\textasciitilde 99.5%, Sigma Aldrich, Germany), 30 wt% Super P carbon black (IMERYS, Switzerland) and 10 wt% polyethylene oxide (PEO, M\textsubscript{w} = 4,000,000 g mol\textsuperscript{-1}, Sigma Aldrich, Germany) binder through a turbo stirring, using acetonitrile (\textasciitilde 99.8%, Sigma Aldrich, Germany) as a solvent. The resulting slurry was doctor-bladed onto a carbon-coated aluminum foil. After drying at room temperature for 24 h,
the electrodes were punched out to form 13-mm-diameter discs. The sulfur loading was ~1.7 mg per electrode (~1.3 mg_sulfur cm^-2).

Li–S electrodes were assembled inside an argon-filled glove box into coin-type cells, using Celgard 2400 as a separator and metallic lithium (≥99.9%, 0.75 mm thick, Alfa Aesar, Germany) as the counter electrode. The cells were filled with 30 or 50 µL of electrolyte containing 1 M lithium bis(trifluoromethane sulfone)imide (LiTFSI) in dimethoxyethane (DME):1,3-dioxolane (Diox) (2:1) (BASEF, Germany), with or without 0.4 M LiNO_3 (≥98%, Fluka, Germany) additive. The electrolyte-to-sulfur ratio was then 18:1 (mL:g S) when using 30 µL of electrolyte, and 29:1 (mL:g S) when using 50 µL of electrolyte in the cell.

The cells were galvanostatically cycled between 1.8 and 2.7 V vs Li^+/Li at different C-rates (1C rate is defined as I=1672 mA A_sulfur^{-1}) using an Astrol (Switzerland) battery cycler. The capacities are given per mass of sulfur, and only the discharge capacity (reduction of the sulfur) is presented. For each set of experimental parameters tested, at least two cells were evaluated to confirm reproducibility of the results.

**Results and Discussion**

**Effect of charge rate.**—The first rate-capability tests were performed with charge rates decreasing from 2C to C/100 (three cycles at each rate) while the discharge rate was kept constant at a low rate of C/20 to ensure full lithiation of the sulfur. Figure 2a shows the electrochemical performance obtained with this cycling protocol for cells containing 50 µL of electrolyte. When these cells are cycled with or without LiNO_3 additive, the variation of the charge rate alone has in fact quite little effect on the capacity reached during discharge (Figure 2a). This suggests that charging is completed independently of the applied charge rate within the tested rate-range, which, in turn, means that the reactions during the charging process are rather fast. However, with LiNO_3 as electrolyte additive (Figure 2a, red symbols), the capacity of the cell is higher than without LiNO_3 (Figure 2a, blue symbols), stabilizing at ~750 mA h g^-1 instead of ~600 mA h g^-1 independently of applied charging rate. The most significant effect of the additive is seen in the coulombic efficiencies of the cells. The coulombic efficiency of the cell without electrolyte additive decreases (Figure 2a, blue stars) with decreasing charge rate; that is, the charge capacity is higher. This is a result of the so-called polysulfide-shuttle effect becoming more pronounced. During the charging process and especially at low rates, the long-chain polysulfides can diffuse to the negative electrode and react with lithium to generate shorter-chain polysulfides, and these then may subsequently diffuse back to the sulfur electrode to be re-oxidized again into longer-chain polysulfides, resulting in the process often referred as polysulfide shuttle. The current associated with these reactions, exhibiting a characteristically longer charge plateau, does not contribute to the reversible capacity of Li–S cells. For C/20 and lower charge rates, the cells cannot be fully recharged to 2.7 V vs Li^+/Li but exhibit instead an ‘endless’ voltage plateau well below the upper cutoff potential (Figure 2b, orange line). In contrast, the coulombic efficiency of the cell with LiNO_3 as electrolyte additive (Figure 2a, red stars) is close to 100%, independently of the charge rate applied, confirming the findings reported by several groups that LiNO_3 helps to reduce the polysulfide shuttle in Li–S cells by passivating the surface of the negative metallic lithium electrode. Based on this observation, it is clear that the rate-capability performance will be negatively affected when the rate-capability tests are started with low charge rates — unless an electrolyte additive is used.

Although the charge rate does not significantly affect the measured capacity, it has a strong influence on the charge overpotential for cells cycled with and without additive. The voltage profiles of cells of either type (Figure 2b – without additive, and Figure 2c – with LiNO_3) show that the overpotential of the charge plateau decreases with decreasing charge rates. This overpotential decrease at lower cycling rates is most probably due to the longer time available for the full Li_2S oxidation. The observed overpotential has a strong impact on the long-term cycling stability of Li–S cells and should be taken into account when choosing the cycling rate for a particular Li–S system. As an example, one can erroneously conclude from Figure 2a that charge rates as high as 1C or 2C are suitable for Li–S cycling, given that they lead to high capacity and high coulombic efficiency during the rate capability test, even without LiNO_3 as an electrolyte additive. However, when the number of cycles is increased (keeping the discharge rate at C/20), the capacity obtained with these high charge rates fades very quickly to below 400 mA h g^{-1}, already after 20 cycles at 1C charge, and after 10 cycles at 2C charge (Figure 2d). At the same time, cells charged at C/5 still deliver 550 mA h g^{-1} even after the 50 cycles. From this experiment it can be concluded that it is of central importance to confirm any good rate-capability performance by long-term cycling experiments, which is rarely done.

**Effect of discharge rate.**—For studying the effect of discharge-rate variation, the charge rate was kept at the intermediate rate of C/5, to minimize the overpotential without significantly increasing coulombic efficiency. In a first phase, the discharge rates were increased every three cycles from lowest (C/100) to highest (3C) rate, to ensure complete lithiation during the first cycles. When 50 µL of
electrolyte was used, and independently of the presence of an electrolyte additive, the discharge capacity decreases with increasing discharge rate from ~700 mAh g\(^{-1}\) at C/50 to below 200 mAh g\(^{-1}\) at 2C (see Figure 3a, blue symbols, and Figure 3b, red symbols). This decrease in capacity is mainly caused by the shortening of the lower discharge plateau, associated with the reduction to solid Li\(_2\)S, and the increase of its overpotential (Figure 3c and Figure 3d). In recent modelling study this type of overpotential increase was attributed to differences in Li\(_2\)S precipitation process\(^{38}\) leading to: (i) a change in the electrolyte resistance due to the variation in concentration of polysulfides and Li-ions, which are formed in large quantities at high rates, (ii) the need of a larger activation overpotential with high currents to overcome the deposition of insulating Li\(_2\)S, and subsequent decrease of available surface area, and (iii) a shift of the reduction potentials due to the consumption of the active species. In our work at discharge rates higher than 1C, the overpotential is so high that the lower-plateau reactions do not occur within the voltage window studied (Figure 3c and Figure 3d). In this case, the measured capacity is only due to the reactions of the upper plateau, that is, reduction of sulfur and formation of long-chain polysulfides. The length and the overpotential of the upper plateau are not strongly affected by the increasing discharge rates, in agreement with previous studies,\(^ {22,25}\) but in contradiction to mathematical models\(^ {30,46}\) where in simulated discharge curves a strong overpotential is affecting also the upper plateau at higher cycling rates. This experiment confirms that the kinetics of the upper-plateau reactions is much faster than that of the lower plateau.

In addition, these experiments also highlight that the use of different cutoff voltages in rate-capability tests may lead to different results, as reflected in the literature, where both very low (for example, 1 V vs Li\(^+/\)Li\(_0\))\(^{12,25}\) and high (for example, 1.9 V vs Li\(^+/\)Li\(_0\))\(^ {47}\) cutoff potentials have been used. If the discharge is stopped at 1 V vs Li\(^+/\)Li\(_0\), the required potentials for the activation of the lower plateau may still be reached even at high discharge rates. In contrast, the lower-plateau reactions cannot be completed already at intermediate discharge rates if the discharge is limited to a higher potential.

In the rate-capability test with constant charge rate and varied discharge rates, the coulombic efficiency is close to 100% when LiNO\(_3\) is added to the electrolyte (Figure 3b, red symbols), without any significant change relative to the previous results obtained with constant discharge rate and decreasing charge rates (Figure 2a, red stars). Without additive, however, the maximum coulombic efficiency achieved is below 90%, and even lower for very low and very high discharge rates (Figure 3a, blue symbols). In the case of very low discharge rates this is probably caused by the diffusion of the long-chain polysulfides to the lithium counter electrode, where they further react, and/or by the loss of active material in the dead space of the cell. At very high rates, these polysulfides are present in high concentrations as they are only partially reduced to shorter-chain species and not reduced to Li\(_2\)S due to large overpotentials; upon charging, the polysulfide shuttle may then occur again. To confirm this hypothesis of polysulfide migration and to minimize the polysulfide diffusion, two approaches were further followed: (i) changing the rate order; that is, the rate-capability test is started with high discharge rate and the rate is decreasing, to quickly transform long-chain polysulfides into short-chain polysulfides at the initial cycling stage, and, therefore, to avoid their diffusion and loss of active material during the first cycles; (ii) decreasing the electrolyte amount to 30 \(\mu\)L, to limit the active-material loss by diffusion of the polysulfides into the dead space of the cell.

Figure 4a shows the rate-capability performance when the discharge rates are decreasing. The starting rate was chosen to be 1C, as it was observed in the previous tests that higher rates are not suitable to completely discharge cells containing 50 \(\mu\)L of electrolyte. In agreement with our hypothesis, it is observed (Figure 4a, blue stars) that the maximum coulombic efficiency reached without additive is 92%, which is slightly higher than the maximum (88%) reached when the rates were increasing. This clearly demonstrates that the order in which rate tests are performed has an effect on the polysulfide Shuttle and on the rate-performance results. Importantly, the capacity at a given rate (except for C/100) is higher when the rates were decreasing (Figure 4b, orange symbols) compared to the results obtained with increasing rates (Figure 4b, purple symbols) both with and without electrolyte additive. In other words, the Li–S cell is not only able to show reasonably good rate capability when the first cycles are performed at a rate as high as 1C, but it is even capable to deliver higher capacity than in the case when the first cycles are performed at low rates — and where, therefore, the loss of active material is occurring. This observation on whether performing the first cycle at slow rate, as has been done in number of cyclability studies,\(^ {8,15,40,49,50}\) has a beneficial effect on the overall test results. The lower capacity measured at very slow cycling rates, for decreasing rate
test (Figure 4b, purple symbols), is a consequence of processes that have occurred in the previous cycles, that is, either active-material loss by diffusion, or restricted sulfur utilization in the depth of the electrode due to the deposition of insulating Li$_2$S on the electrode surface.\textsuperscript{15,16}

In both cases — decreasing and increasing rates (Figure 3 and Figure 4) — the discharge rate has a significantly stronger influence on the measured reactions than the charge rate (Figure 2), showing that the discharge reactions are limiting in the Li–S system, in agreement with the findings of Kulisch et al.\textsuperscript{15} It is therefore misleading to compare the rate capability of cells where the overall cycling rate is changing (with both the charge and discharge rates being the same in individual cycles) with that where the cycling rate is only varied on charge\textsuperscript{15,16} and where for that reason the performance might appear superior.

In experiments to test the second part of our hypothesis, the rate-capability test using increasing discharge rates was performed with a smaller amount of electrolyte (Figure 5). The capacity obtained with a lower amount of electrolyte (30 μL) depends much more strongly on the discharge rate than that obtained with a higher amount of electrolyte (50 μL), both with and without LiNO$_3$ additive (Figure 3a and Figure 3b). At lower discharge rates, the capacity is higher for the smaller electrolyte amount (Figure 3a, light-blue symbols, and Figure 3b, brown symbols), due to the reduced loss of active material in the dead volume of the cell. This also leads, as expected,\textsuperscript{8,24,48} to a higher coulombic efficiency when electrolyte without additive is used (Figure 3a, light-blue stars). Nevertheless, one should bear in mind that decreasing the electrolyte amount even further may lead, especially for long-term cycling (≥100 cycles), to a decrease of the coulombic efficiency due to the drying up of the cell (decomposition of electrolyte due to reaction with metallic lithium), and/or, in presence of LiNO$_3$, to the consumption of available additive.\textsuperscript{9} When LiNO$_3$ quantity is sufficient, as in our study, the capacity with lower amount of electrolyte is even higher at low rates than without additive, since the polysulfide shuttle is suppressed (Figure 3b, brown symbols) most probably due to concentration effects.\textsuperscript{20,39} In contrast, at higher discharge rates, the capacity with the smaller amount of electrolyte is lower. This is in agreement with previous studies,\textsuperscript{9} confirming that the smaller amount of electrolyte leads to a higher concentration of polysulfides and, thus, to higher electrolyte viscosity, which in turn results in lower ionic conductivity\textsuperscript{52,57} hindering electrolyte permeation into the depth of the electrode. This results in discharge profiles with characteristically large overpotentials and, consequently, in a lower capacity when using reduced amounts of electrolyte (Figure 3e and Figure 3f) in combination with higher cycling rates.

In addition, rather surprisingly, when analyzing the voltage-profile plots with both amounts of electrolyte it was observed that the charge overpotential is larger at slower discharge rates, despite the constant charge rate (Figures 3e–3f). This is most probably caused by the state of Li–S system at the end of the discharge. To visualize this effect, the potential at the charge onset and the length of the lower discharge plateau of the corresponding discharge were determined from the voltage profiles of the rate capability tests (Figure 2 and Figure 3) and plotted as a function of the charge or discharge rates (Figure 5). Figure 5a (red symbols) clearly shows that the higher the discharge rate
(at constant C/5 charge, as in Figure 3), the lower the initial charge overpotential (at charge onset), both with and without electrolyte additive. This correlates well with the relationship between the capacity of the lower discharge plateau and the discharge rates (Figure 5b, red symbols). In other words, the lower the Li–S cell discharge rate, the larger the amount of polysulfides that is reduced to Li2S, resulting in longer lower discharge plateau. Therefore, during the following charge, the slow Li2S oxidation leads to an overpotential proportional to the amount and/or quality of formed Li2S. The observed overpotential is larger for lower discharge rates due to the fact that more of the crystalline Li2S is formed at slow discharge, and this crystalline Li2S is more difficult to oxidize than the amorphous one, formed at fast discharge.53 One can also note that the large charge overpotential observed at 2C discharge (Figure 5a, red symbols) is probably due to a limitation brought on by polysulfide concentration near the sulfur-electrode surface. At this high rate, soluble long-chain polysulfides are actually not reduced to Li2S and only partially to shorter-chain polysulfides in the studied voltage window due to large overpotential on discharge, leading to the absence of the lower discharge plateau (Figure 5b, red symbols) and, at the same time, to a higher potential at the start of the charge. At constant C/20 discharge rate (as in the experiments shown in Figure 2), the degree of discharge is not significantly affected by the charge rates, and the capacity of the lower discharge plateau is almost constant and relatively high (Figure 5b, blue symbols), suggesting a high amount of Li2S being formed. However, when the charge rates are varied, the correlation between the charge overpotential and the charge rate (Figure 5a, blue symbols) is opposite to that for discharge-rate variation (Figure 5a, red symbols). In the case of varied charge rates, an increase in the applied charge-current leads to a strong increase in the Li2S oxidation overpotential.

**Determination of the optimal cycling conditions.**—To achieve good cycling performance, a Li–S cell should deliver (i) high capacity, (ii) high coulombic efficiency, and (iii) should have low overpotentials, in both charge and discharge, to assure good cycling stability. In this study it was shown that for simple Li–S cells (i) quite low discharge rates are required to complete sulfur lithiation, given the limiting reaction rates at the lower discharge plateau, whereas higher rates require higher amount of electrolyte to enable greater sulfur utilization; (ii) however, the electrolyte amount should be low to minimize diffusion of long-chain polysulfides into the dead space of the cell, or the cycling rate should be high to limit the time for polysulfide diffusion; (iii) the charge rate should be sufficiently low to minimize the overpotential due to the slow Li2S oxidation. In particular, it is clear from our results that rates of 1C or higher are not suitable to fully charge our model Li–S cells. However, this is not necessarily the case for all Li–S cell/electrode types, as there are data in the literature showing that some Li–S systems are able to deliver reasonably high capacity at rates of 1C or more during long-term cycling,17,38,46,49,50,54,55 although their sulfur loading and/or relative content are often rather low, and far from the ones needed in practical applications.56

For our model electrodes, according to the rate-capability test with constant discharge rate (Figure 2), a charge rate of C/5 is a good compromise for minimizing both the charge overpotential and the polysulfide diffusion, and it is also suitable for long-term cycling (Figure 2d). The tests with constant C/5 charge rate (Figure 3 and Figure 4) suggest that discharge rates between C/5 and C/20 are suitable to minimize the discharge overpotentials and to minimize the polysulfides diffusion, while maximizing sulfur utilization. It was also observed that for these low discharge rates and C/5 charge rate, higher capacity and coulombic efficiency were obtained when the electrolyte amount was lower, namely 30 μL (Figure 3). Motivated by these findings, constant C/5, C/10 and C/20 discharge rates were studied further for long-term cycling (100 cycles) with C/5 charge-rate using 30 μL of electrolyte (Figure 6), as discrepancies between rate-performance and long-term cycling results have been observed. The electrolyte without additive was used in order to highlight the effect of the cycling conditions on the coulombic efficiency, as addition of LiNO3 in previous experiments (Figure 2a and Figure 3b) increased the efficiency close to 100%, independently of the cycling rate. Figure 6 shows that a decrease of the discharge rate from C/5 to C/10 enables a better utilization of the active material for the first few cycles. However, this slower rate also induced loss of active material by diffusion of the long-chain polysulfides, leading to lower coulombic efficiency and capacity, as seen already after a few cycles. With the slower discharge at a C/20 rate, this effect is even more pronounced, leading to ‘endless’ charge after 50 cycles. This test shows that a discharge rate of C/5 appears to be most suitable as the capacity of 680 mAh g−1 is still obtained even after 100 cycles with a coulombic efficiency as high as 94% without using any electrolyte additive.

However, the limited amount of electrolyte leads to problematic active-material utilization due to the high concentration of polysulfides and, as a result, a high electrolyte viscosity. We also know from our previous work48 that, in agreement with the rate-capability tests (Figure 3) and despite the decrease in electrolyte viscosity, the long-term performance at C/5 charge and discharge is inferior when the electrolyte amount is higher (50 μL). Therefore, this line of experiments was not pursued further. Instead, our approach to increasing sulfur utilization was to apply a potentiostatic step at the end of the discharge, keeping the potential at 1.8 V for 5 hours, enabling the full conversion of polysulfides to Li2S. This potentiostatic step does indeed result in a higher capacity for 60 cycles (Figure 6, pink symbols); however, in later cycles, the capacity of this cell becomes comparable to the one cycled without potentiostatic step, which means that the performance increase is short-lived. It is also noteworthy that the coulombic efficiency is only slightly affected by the potentiostatic step, showing that this cycling protocol does not facilitate diffusion of polysulfides, but mainly the formation of end products. Although this cycling method might not be suitable for practical systems, we observe clear differences, even if temporary, to the performance of the cells and therefore the cycling protocols used in any test of a Li–S system should be fully disclosed. In particular, potentiostatic steps (if any) should be reported.

From the results of the rate-capability tests described above one can readily see that long-term cycling is needed to prove that any enhancement in rate capability is not transient, and that the cell can sustain its performance without the drawbacks of high overpotentials emerging during extended cycling at high rates. Long-term cycling is as well necessary to find a compromise between cycling rates and electrolyte amount for best long-term performance, and, therefore, to determine the optimal cycling set-up and conditions. We have established such optimal cycling conditions for the model Li–S system used in this study, but the same methodology can be adapted to any kind of Li–S electrode or cell type.
Conclusions

Our results highlight the pitfalls in assessing the performance of various Li–S systems when different cycling protocols are used, and bring to the fore the importance of standardizing the rate-capability tests to provide a comparison without bias. We demonstrated, using a model Li–S cell and a systematical approach, that the electrochemical performance of the Li–S cell is dependent not only on the magnitude of the applied current (cycling rate) but also on the cycling prehistory of the cell. The rate-capability results are different: (i) if the applied cycling protocol is based on increasing or decreasing cycling rates; (ii) if increasing and decreasing rates are applied solely on charge, solely on discharge, or for the entire cycle; (iii) if the electrolyte composition and/or amount are not the same.

The practical capacity delivered by the Li–S cell is mainly affected by the discharge rate, as the reduction to Li$_2$S is a slow process, and by the choice of the lower cutoff potential, as full discharge might not be reached at higher rates, due to increased overpotentials. Furthermore, the state of the sulfur electrode at the end of the discharge influences both the obtained discharge capacity and the overpotential of the following charge. The charge rate does not significantly influence the capacity, due to the fast kinetics during the charging process, at least on the short term; the rate capacity would erroneously appear impressive if only the charge rate is varied. The charge rate has, however, an effect on the charge overpotential, due to the slow Li$_2$S oxidation. This overpotential, if too high, leads to cell failure during long-term cycling, despite good performance for a limited number of initial cycles.

Low cycling rates in the first cycles of the rate-capability test and an excess of electrolyte both intensify the diffusion of polysulfides within the cell, resulting in a greater loss of active material and thus in lower capacity and in lower coulombic efficiency, leading to conditions where the cell cannot be recharged when no electrolyte additive is present. In contrast, at higher cycling rates limited electrolyte availability leads to insufficient sulfur utilization. Then the use of a constant voltage step at the end of the discharge protocol positively affects the short-term performance and a fortiori the rate-capability results. This underlines the importance of carefully choosing the order of applied rates (increasing or decreasing) and the finding that in theoretical studies oftentimes not all parameters affecting the functioning mechanism of the Li–S battery at different rates are considered.

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