Dear Editor and Reviewer,

Thanks very much for your letter and for the reviewers' comments concerning our manuscript. Those comments are all valuable and very helpful for revising and improving our manuscript, as well as the important guiding significance to our researches. We have studied comments carefully and have made correction which we hope meet with approval. Revised portion are marked in red in the 'Revised manuscript'. The response to the reviewer's comments and the main corrections in the manuscript are as follows:

Reviewer 1

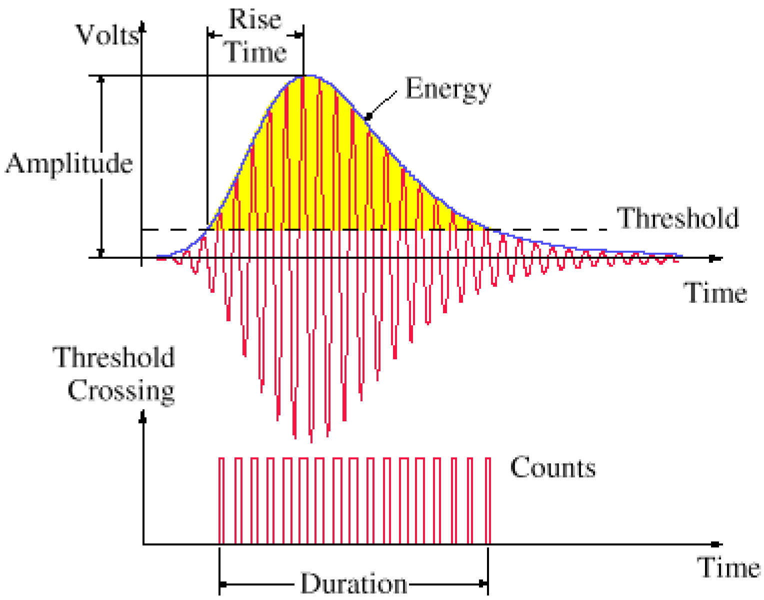
Thanks very much for the valuable comments from the reviewer. The improvement of the manuscript has been made according to the comments and questions. The responses to each comment or question are as follows.

Comments and Suggestions for Authors
Since this paper refers existing researches on the correlation between the AE signal and the corrosion phenomenon, the novelty of this research is considered to be your analysis method of the AE signal.

However, the description in "3.4 Clustering analysis" is insufficient, and correction is necessary.

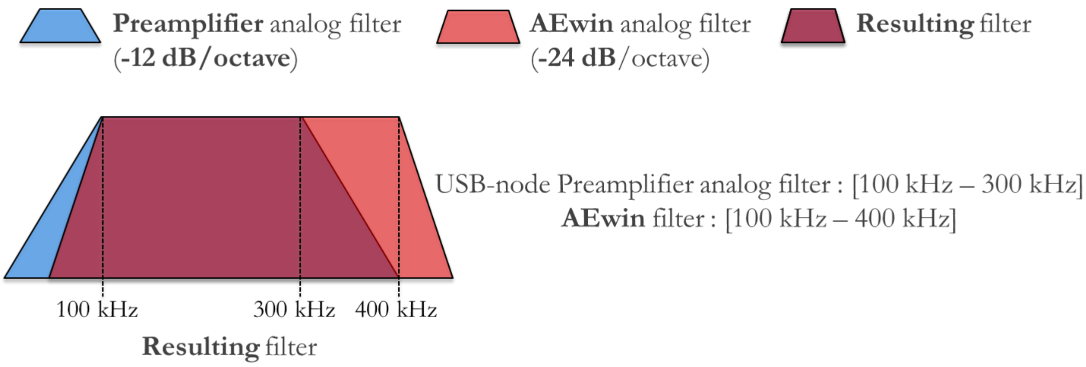
What are the durations, counts, average frequency, which are labels of axes in Fig. 8 and 9? There are no units in these labels.

A: The number of times the signal rises and crosses the threshold is the count of the AE event. The time period between the rising edge of the first count and the falling edge of the last count is the duration of the AE event. The average frequency (Hz) is calculated from N_{AE}/t_{AE}, to estimate the characteristic frequency of an AE event. The labels information with units have been added in Fig. 8, 9 and 10.



If the unit of average frequency is kHz, considering that the frequency bandwidth of the analog filter is 100-400 kHz, there are many plots outside this bandwidth.

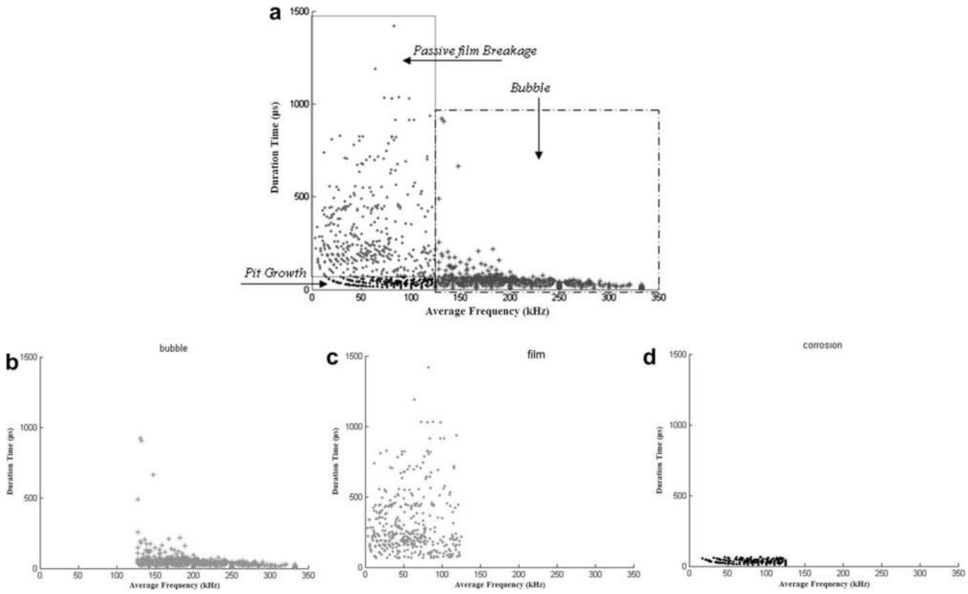
A: Yes, there are many plots outside the bandwidth of 100-400 kHz theoretically. However, there are 3 stages of filtering for acquisition: Preamplifier analog filter (-12 dB/octave), AEwin embedded analog filter (-24 dB/octave), Waveform filtering (optional | custom). The maximum bandwidth of the analog filter depend on the preamplifier's physical property (100 kHz – 300 kHz for USB-node). Furthermore, the signals of corrosion phenomena are mainly in low frequency range.



Furthermore, there are no quantitative criteria describing to classify the group of plots into three groups.

The subjective classification of authors such as low and high is applied also in Fig. 10, and it is impossible for the reader to verify these results.

A: We appreciate for this very valuable comments. Indeed, there are no quantitative criteria for plots classification in the manuscript, even some paper proposed criteria as shown in the following figure. However, we don't think there exists strict criteria because the fact is that if we check the waveform of nearby AE signals, it is barely to see big difference both in shape and comprehensive parameter analysis. It is true that the cluster method based on parameter correlation diagram (i.e. duration vs. average frequency) could classify the signals to some extent. For instance, by checking the waveform of each signal one by one, four types in shape could be find in three classification domains in this investigation. Some parameters like break-up frequency and resonant frequency have been used. However, their values are highly relied on AE system setup and corrosion experiment condition. In summary, we think researchers haven't find a criteria based on the solid scientific meaning. Our investigation more emphasize the data pre-treatment method which improved the classification diagram. Before the data pre-treatment, four types waveform is very difficult to find out, but could be easy identified after the pre-treatment.



Mechanism and source identification on pitting corrosion by AE. (a) All AE sources. (b) Bubble. (c) Passive film rupture. (d) Pitting corrosion. (C. Jirarungsatian, A. Prateepasen, Pitting and uniform corrosion source recognition using acoustic emission parameters, Corrosion Science 52 (2010) 187)

The logical development in "3.5 Corrosion type identification" is also unclear, and correction is necessary.

A: Thanks very much for the comments. The corrections have been made in the revised manuscript, marked in red.

Did you compare the type of corrosion distinguished by AE signal with the teacher data that was pattern-recognized beforehand and investigated those similarity?

A: There is no need of teacher data for pattern recognition in our calculation method. The advantage of this corrosion type identification method is fast and no need of teacher data. This paper only finished the first step – confirming this method is able to distinguish different corrosion types. It gives a new possible way to analyze the AE signals in-situ very quickly and directly.

Even if there are existing researches, criteria for distinguishing corrosion types with AE signals should be described to some extent.

A: Many types of corrosion have been studies by AE, such as general corrosion stress corrosion cracking, abrasion or erosion corrosion, and pitting corrosion, referenced in [17-25] in the introduction part. However, there is no criteria for distinguishing corrosion types, because different experiment with the same corrosion mechanism may have very different AE behavior since many other factors (such as material, stress level …) would affect the AE waveform. The typical methods for distinguishing corrosion types includes AE parameters cluster (i.e. k-means), ensemble learning method (i.e. random forest). These method only utilize some parameters of AE waveform (raw or pre-treated) or relied on big data. The method introduced in this manuscript can directly use the waveform. In the first step, we proved this method is able to distinguish different corrosion types. It gives a new possible way to analyze the AE signals in-situ very quickly and directly. We have added some discussions at the beginning of 3.5 section.

It is strongly recommended to clearly show the specific flow for obtaining the results in Table 3.
A: The calculation procedure has been explained in the revised manuscript.

Reviewer 2:

Thanks very much for the valuable comments from the reviewer. The improvement of the manuscript has been made according to the comments and questions. The responses to each comment or question are as follows.

Comments and Suggestions for Authors

The work is very interesting and very well presented from a scientific point of view. Inevitably the treatment of acoustic emission signals is very complex for interested readers and experts in steel corrosion, and not in AE. It would therefore be desirable to have a more detailed description of this process. In any case, in my opinion the authors present a well-founded demonstration that their method of acoustic emission is capable of detecting and corrosion of carbon steel in that medium and even more of distinguishing between a uniform corrosion process or localized corrosion. However, from the point of view of a real application of this methodology to the control of corrosion of carbon steel structures, the important parameter is not so much the OCP as the corrosion current density. Parameter that effectively determines the loss of material. In my opinion, the biggest flaw in the manuscript that the authors should explain is whether in their opinion it is possible to correlate the AE with the corrosion rate of carbon steel.

A: Thanks very much for the positive comments. We totally agree with the reviewer's opinion about the issue of the correlation between AE and corrosion rate. However, this manuscript can not answer whether the quantitative correlation could be possible established between AE and the corrosion rate of carbon steel. The relevant discussion has been added in the manuscript at the last part of section 3.4. From our view, if the carbon steel presents localized corrosion or its corrosion type combined with localized corrosion to some extent, it is unlikely to find the quantitative correlation between AE data and corrosion rate. But if the carbon steel presents a typical uniform corrosion under the same mechanical condition, it is possible. Some positive results have been reported by A. Prateepasen in the investigation of pitting and uniform corrosion source recognition using acoustic emission parameters (Corrosion Science 52 (2010) 187–197).

Thanks very much for the valuable comments from the reviewer. The improvement of the manuscript has been made according to the comments and questions. The responses to each comment or question are as follows.

Reviewer 3:
Comments and Suggestions for Authors

The work is too interesting and well oragnized. This work can be accepted after minor revisions. The following points have to be considered into this manuscript before acceptance:

What about passivation and re-passivation behavior/role of such materials investigated.

A: For carbon steel, the re-passivation of pitting refers to the stop of the corrosion in the pit. It has been clarified in the revised manuscript. The passivation refers to the stable oxide film without localized corrosion formed on the carbon steel, or say no obvious corrosion happen.

Could the polarization curves (Evan Diagrams) be included in this work for more clearness.

A: The purpose of this investigation is to perform the in-situ AE monitoring in the natural immersion test of carbon steel. As discussed in the introduction part, most of the researchers used some methods such as potentiodynamic polarization, potentiostatic polarization or heater to accelerate the pitting corrosion of metals in a short time so that it could not be the real situation of the corrosion process of materials under natural conditions.

Actually, the immersion test solutions is chosen close to the solution used in the previous study (Tang, Y.M.; Zuo, Y.; Zhao, X.H. The metastable pitting behaviors of mild steel in bicarbonate and nitrite solutions containing Cl-. 2008, 50, 989, reference 5 in the manuscript). The relevant polarization curves can be find in this paper as shown below. It also can confirm the passivation, re-passivation behavior of carbon steel in $NaHCO_3$ + NaCl solutions. The text in the last paragraph of the introduction part has been revised for more clearness.

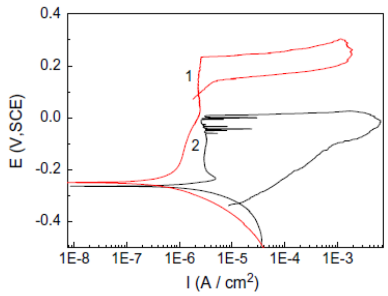


Fig. 1. Polarization curves of mild steel in: (1) 0.3 M NO_2^- + 0.05 M Cl^-, (2) 0.3 M HCO_3^- + 0.05 M Cl^-.

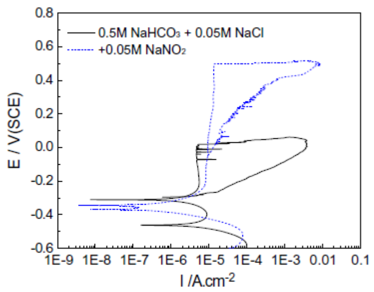


Fig. 8. The effect of NO_2^- anion on polarization behavior of mild steel in $NaHCO_3$ + NaCl solution.

How this technique could be applied practically and for which applications (main application).

A: This technique could be applied to the in-situ monitoring for the corrosion of carbon steel container in different industries and the reinforcing steel bar for building, bridge (especially in marine corrosion environment). It also can applied in stainless steel container corrosion.

It has been added in the conclusion of manuscript.

What is the main obstacle of using this technique (acoustic emission)? (probability of Passive layer break down??.

A: The advantages of AE technique include the sensor on the outer surface of metal container, non-destructive, high sensitivity … but its data processing will be very difficult when the noise from environment (i.e. mechanical or electronical noises) is high.

It has been added in the conclusion of manuscript.

The main difference between AE technique and OCP one. The most attarctive points should be clear in this work.

A: As indicated from the results in section 3.1, the AE events directly associate to the corrosion phenomena such as passive film breakdown, hydrogen evolution, pit propagation, etc. compared with OCP monitoring only reflects the general electrochemical thermodynamic information. Thus all the stages of corrosion are possible detected by AE monitoring. However, the OCP is only sensitive to the corrosion initiation stage because only the corrosion initiation has the significant change in corrosion potential.

The discussion above has been added in the last paragraph of section 3.1 in the revised manuscript.

We tried our best to improve the manuscript and made some changes of this manuscript. These changes will not influence the content and the framework of the paper. And here we did not list the changes but marked in red in revised manuscript.

We appreciate for Editors and Reviewers' warm work earnestly, and hope that the correction will meet approval.

Once again, thank you very much for your comments and suggestions.

Yours sincerely,

Junlei Tang