# Article information:

Revisiting stress-corrosion cracking and hydrogen embrittlement in 7xxx-Al alloys at the near-atomic-scale | Nature Communications  
<https://www.nature.com/articles/s41467-022-31964-3>

# Article summary:

1. The 7xxx series Al alloys are extensively used for weight reduction purposes in aerospace and are poised to see their usage widen due to the global need for light and high-strength materials for e.g. lightweight vehicles and developing the infrastructure for a hydrogen economy.

2. Stress-corrosion cracking (SCC) and hydrogen embrittlement (HE) can occur in 7xxx Al alloys, particularly through generation of hydrogen during SCC, which is driven by both anodic dissolution and HE.

3. A study using transmission-electron microscopy (TEM) and atom probe tomography (APT) found that the corroded crack surface is a Mg-rich, chlorinated amorphous hydroxide, and the composition of the precipitate-free zone (PFZ) and of precipitates near and ahead of the crack is vastly modified, with no increased level of H measured. The study provides insights into the interplay of structural defects and the transport of solutes from the matrix, possibly assisting with the dissolution of strengthening phases, thereby changing resistance against crack propagation.

# Article rating:

May be slightly imbalanced: The article presents the information in a generally reliable way, but there are minor points of consideration that could be explored further or claims that are not fully backed by appropriate evidence. Some perspectives may also be omitted, and you are encouraged to use the research topics section to explore the topic further.

# Article analysis:

The article "Revisiting stress-corrosion cracking and hydrogen embrittlement in 7xxx-Al alloys at the near-atomic-scale" provides a detailed analysis of the microstructural and microchemical changes caused by stress-corrosion cracking (SCC) in 7xxx series aluminum alloys. The authors use transmission-electron microscopy (TEM) and atom probe tomography (APT) to study the direct vicinity of cracks and regions ahead of the main crack, especially grain boundaries along which the crack is expected to grow.

The article highlights the importance of understanding SCC and hydrogen embrittlement (HE) in 7xxx Al alloys, which are extensively used for weight reduction purposes in aerospace and are poised to see their usage widen. The authors note that a holistic, mechanistic understanding of these complex processes is still missing, hindering the development of a materials design strategy to overcome these crucial issues.

The article presents evidence that atomic H is produced at crack tips as a consequence of corrosion, mostly arising from differences in potential between the η-phase, Al-rich matrix, and GB region. The authors observe segregation of H to the GB ahead of the crack and on linear features usually attributed to dislocations. They also find that the corroded crack surface is a Mg-rich, chlorinated amorphous hydroxide.

However, there are some potential biases in this article. For example, it focuses primarily on SCC and HE in 7xxx Al alloys without considering other materials or alternative solutions. Additionally, while APT has been successfully used to map trapped H in steels and Ti-alloys, its application to aluminum alloys may not be as well-established.

Furthermore, while the article provides insights into microstructural changes caused by SCC in 7xxx Al alloys, it does not explore counterarguments or alternative explanations for these phenomena. It also does not provide information on possible risks associated with using these alloys or present both sides equally.

Overall, the article provides valuable insights into SCC and HE in 7xxx Al alloys at the near-atomic scale. However, readers should be aware of potential biases and limitations in the research presented.

# Topics for further research:

* Alternative solutions to stress-corrosion cracking and hydrogen embrittlement in aerospace materials
* Comparison of atom probe tomography and other microstructural analysis techniques for aluminum alloys
* Risk assessment of using 7xxx Al alloys in aerospace applications
* Mechanisms of corrosion and hydrogen embrittlement in other types of aluminum alloys
* Counterarguments to the role of hydrogen in stress-corrosion cracking of aluminum alloys
* Development of materials design strategies to mitigate stress-corrosion cracking and hydrogen embrittlement in aluminum alloys

# Report location:

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