# Increased activity and durability of the OER by using $SrRuO_3$ through doping with monovalent cations


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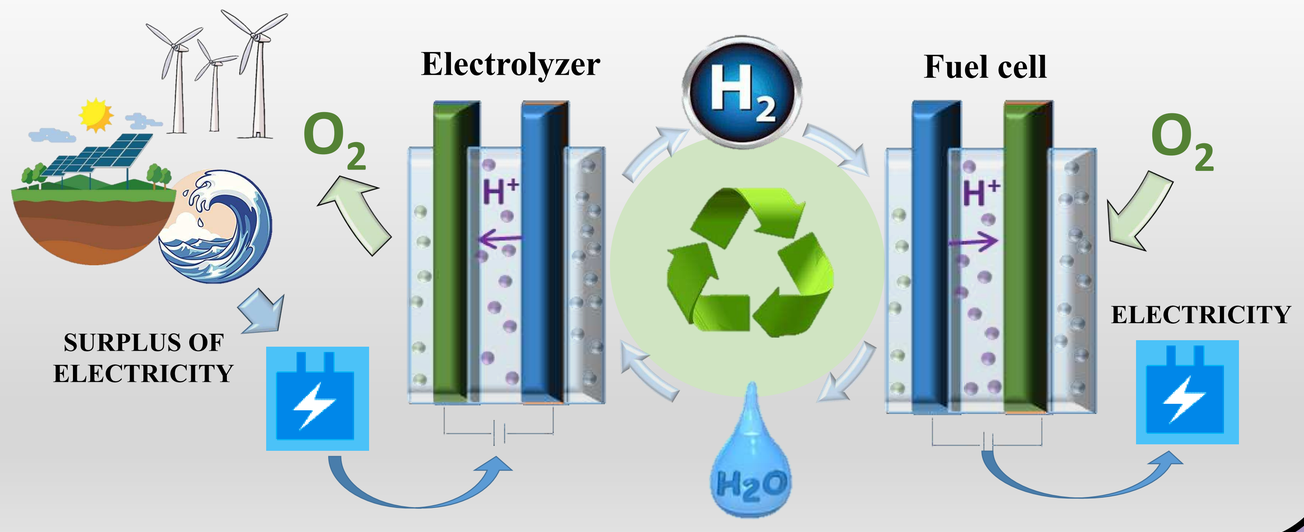
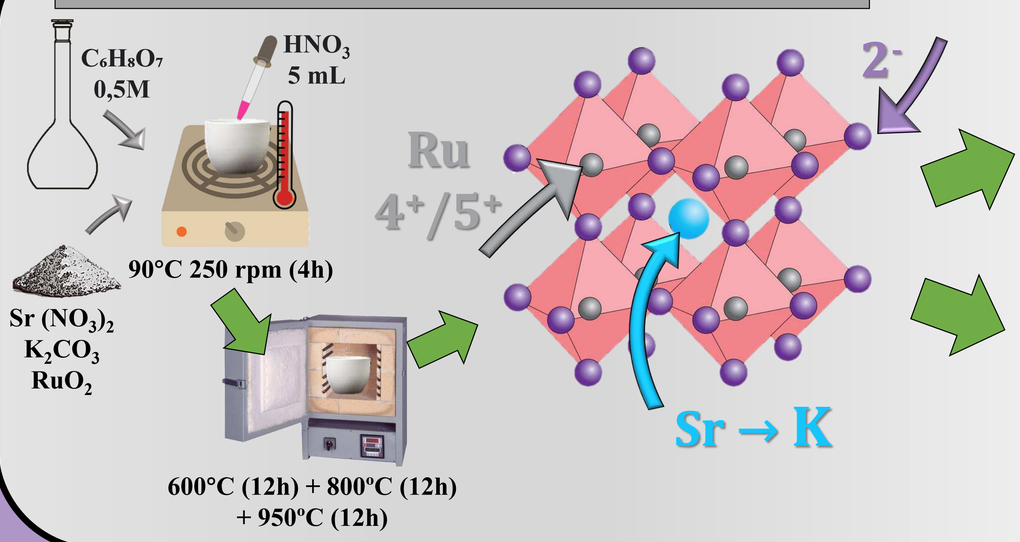
## Introduction

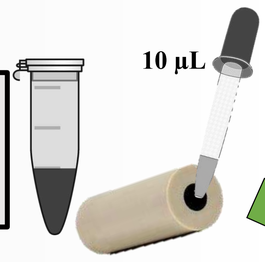
Green hydrogen can allow to reduce carbon footprint of several key sectors or technologies. Therefore, the demand for **green hydrogen** is expected to increase dramatically in the coming years. Water electrolysis using renewable energy is the technology of choice for the production of green hydrogen. In the anode, water is oxidized producing $O_2$, protons and electrons during the Oxygen Evolution Reaction, OER ($2H_2O \rightarrow O_2 + 4H^+ + 4e^-$). In the cathode, $H_2$ is formed through the Hydrogen Evolution Reaction, HER ($4H^+ + 4e^- \rightarrow 2H_2$). **Due to the sluggish kinetics of the OER, this reaction is the limiting step of water electrolysis.** $SrRuO_3$ is one of the most studied mixed oxide for the OER, but its durability is very limited.




## Materials and methods




$Sr_{1-x}K_xRuO_3$ (5mg)
Vulcan (1mg)
Nafion (30 µL)
THF (970 µL)



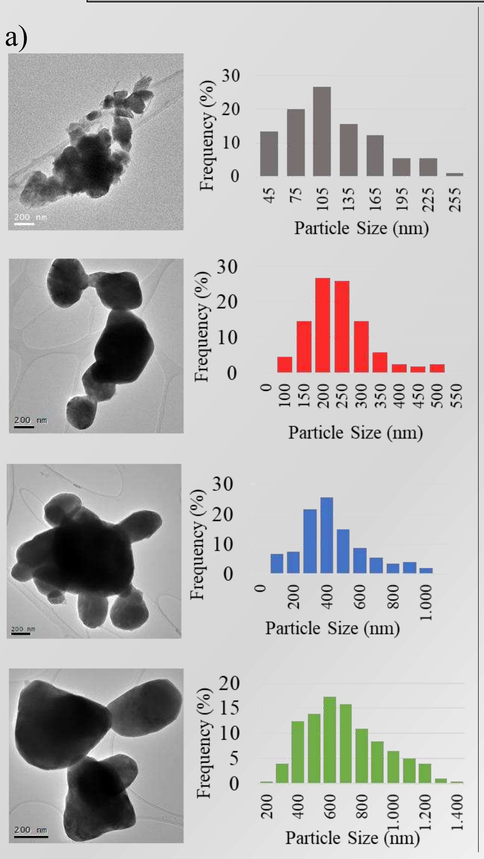


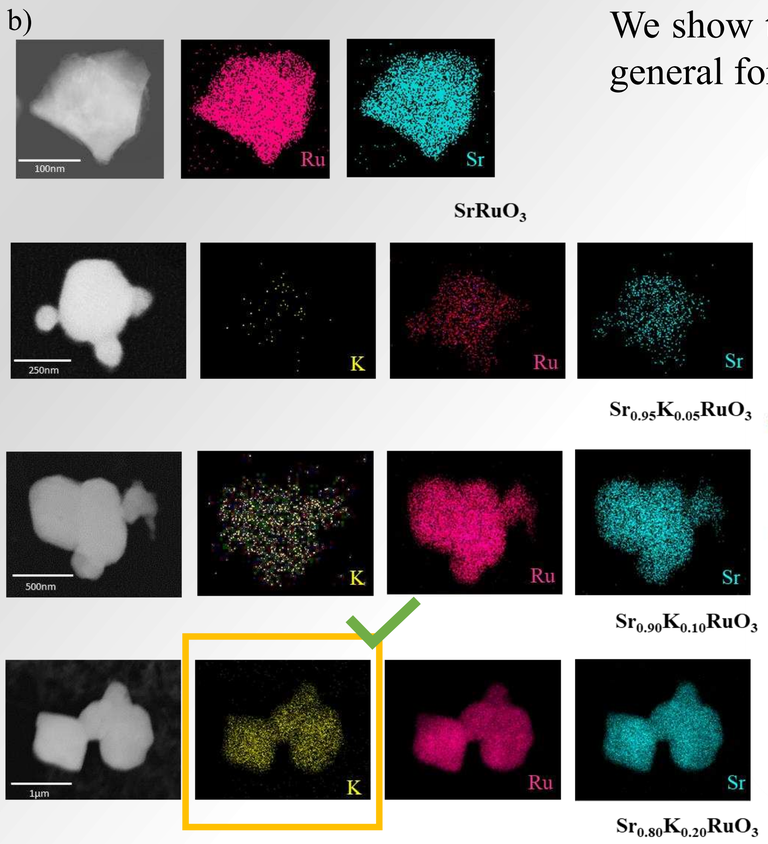
XRD


TEM


$HClO_4$ 0,1M
$O_2$ Saturated

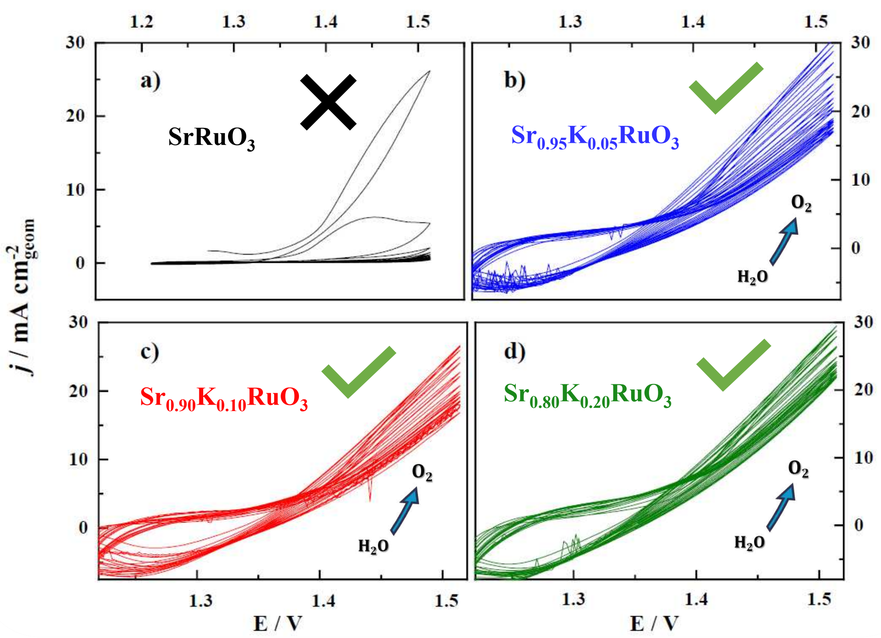

## Results and discussion



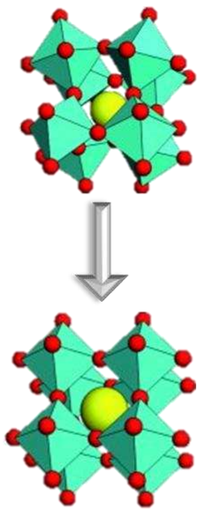




*a) TEM images and particle size for $SrRuO_3$, $Sr_{0.95}K_{0.05}RuO_3$, $Sr_{0.90}K_{0.10}RuO_3$ and $Sr_{0.80}K_{0.20}RuO_3$. (b) STEM images for $SrRuO_3$, $Sr_{0.95}K_{0.05}RuO_3$, $Sr_{0.90}K_{0.10}RuO_3$ and $Sr_{0.80}K_{0.20}RuO_3$ and the corresponding EDX Mapping.*

We show that the partial substitution of **$Sr^{2+}$ by monovalent $K^+$** cations with general formula $Sr_{1-X}K_xRuO_3$, resulted in higher OER activity and durability.




*Evolution of the OER activity during 20 consecutive cycles at 10 $mVs^{-1}$ in $O_2$-saturated 0.1 M $HClO_4$ with $SrRuO_3$, $Sr_{0.95}K_{0.05}RuO_3$, $Sr_{0.90}K_{0.10}RuO_3$ and $Sr_{0.80}K_{0.20}RuO_3$.*



The introduction of $K^+$, due to its greater ionic radius, generates a decrease in the distortion of the perovskite structure.

## Conclusions

We have successfully prepared the series $Sr_{1-x}K_xRuO_3$ perovskites with the substitution of $Sr^{2+}$ by a monovalent cation ($K^+$)
The introduction of $K^+$, due to its greater ionic radius decrease the distortion of the perovskite structure and slightly increases Ru oxidation state (XAS)
Doping Ru perovskites with monovalent cations is a suitable strategy to enhance the OER catalytic performance in acid media, in terms of both activity and durability.

## References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