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Solar water splitting with nanostructured hematite: The role of annealing-temperature

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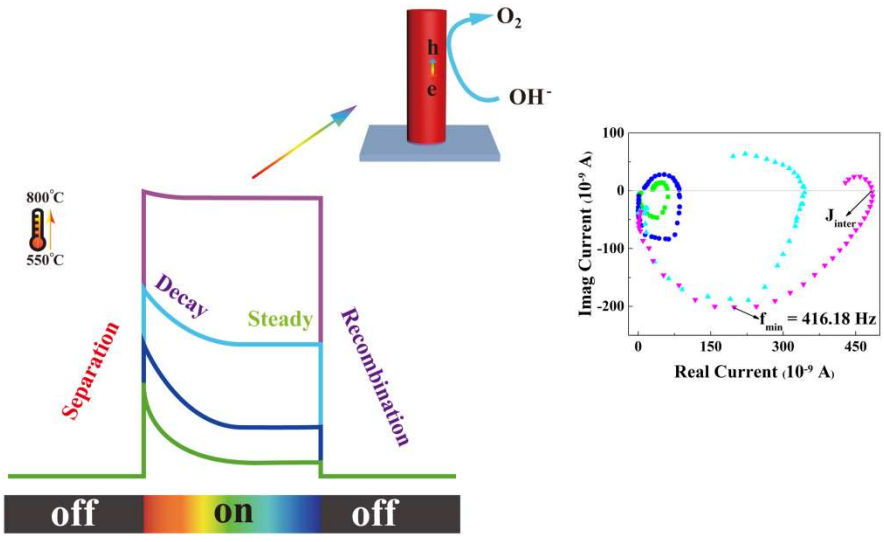
# Graphical abstract

In this study, we apply a two-step annealing method to fine-tune the microstructure of hematite. The influence of annealing temperature on the corresponding photoelectrochemical performance is explored. Multiple surface analyses revealed that the short time high temperature annealing treatment based on long time stabilized treatment have properly activated the PEC performance of hematite. The sample of $Fe_2O_3$-800 showed the best photo activity enhancement and the corresponding photocurrent density was about tenfold higher than that of $Fe_2O_3$-550 sample. The achieved improvement was related with crystallite size and the diffusion and incorporation of Sn atoms. Increasing with the annealing treatment temperature, the sample showed gradually reduced charge transport resistance and suppressed charge carrier recombination process.




**Schematic model of the enhanced PEC water splitting performance by fine-tune the microstructure of hematite after two-step annealing treatment in the temperature range of 550-800 °C.**