Società Chimica Italiana

SCI2021

XXVII CONGRESSO NAZIONALE DELLA SOCIETÀ CHIMICA ITALIANA

LA CHIMICA GUIDA LO SVILUPPO SOSTENIBILE

14–23 SETTEMBRE 2021

Investigation of the mechanism of Pt_3Fe_3 clusters for the hydrogen evolution reaction and for the oxygen reduction reaction

He Xiufang,[a,] Federica Colombo[a], Martina Fracchia,[b], Paolo Ghigna,[b] Sandra Rondinini,[a] Roberto della Pergola,[c] Alessandro Minguzzi,[a] Alberto Vertova, [a]*

[a] Laboratory of Applied Electrochemistry, Dipartimento di Chimica, Università degli Studi di Milano, Via Golgi 19, 20133, Milan, Italy
[b] Dipartimento di Chimica, Università degli Studi di Pavia, Viale Taramelli 13, 27100, Pavia, Italy
[c] Dipartimento di Scienze dell'ambiente e della Terra, Università degli Studi di Milano-Bicocca, Piazza della Scienza 1, 20126 Milano, Italy

With the fast-growing developing economies and the acceleration of industrial development, the demand for renewable, sustainable, and environmental-friendly energy sources is severely increasing [1]. Hydrogen, as a green fuel, attracts our attention and Pt stands out for its good performance in electrochemical production of hydrogen and for its use in fuel cells. However, the price of Pt limits its application and reducing the amount of Pt used in fabricating the electrodes becomes an urgent problem. According to our previous work [2], "Pt-based" clusters are an interesting option to reduce the loading of Pt and they are very stable thanks to a strong bond with the carbon support. Thence, we are studying Pt-X clusters (where X is a second metal) to further reduce the loading and to improve the activity. Therefore, we use Pt-X clusters as the electrode material and deposited it on the *rotating ring-disk electrode* (RRDE) tip to test the performance for the hydrogen evolution reaction (HER) and for the oxygen reduction reaction (ORR), in both alkaline and acidic media. We explored cyclic voltammetry curves (CV) by controlling the rotating speed of RRDE and the scan rate, using different working potential windows as well as N_2 and O_2 condition, in basic and acid media, to illustrate both reactions. Besides, we adopted X-ray absorption spectroscopies (XAS) to investigate the oxidation state and local structure changes of Pt and Fe under operative conditions. From above, we want to study structure-activity relations and provide rational design instructions related to Pt-based clusters and, more in general, to the electrode material for both the ORR and the HER.

[1] H. Lee, X. Wu, L. Sun, *Nanoscale*. 2020, 12, 4187-4218.
[2] M. Fracchia, P. Ghigna, M. Marelli, M. Scavini, A. Vertova, S. Rondinini, R. Della Pergola, A. Minguzzi. *New J. Chem.*, Accept