Effect of oxidation states of vanadium in V-N-C based non-precious metal catalyst for fuel cells in acidic medium

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Abstract

Although, better engineering has advanced PEMFC stack development significantly, expensive components used such as platinum based catalyst limits its commercialization [1]. To tackle this problem, efforts were made to reduce the platinum loading or replace the platinum with cost effective, abundant non-precious metal (NPM) catalyst. Later emerged as promising approach and NPM catalyst based on Fe or Co-N-C has shown encouraging results to replace platinum for ORR [2]. However, Fe or Co based NPM suffer due to poor longevity in acidic medium of PEMFC. This study aims at finding a stable NPM catalyst, which is based on V^{4+}/V^{5+} redox couple. We have obtained preliminary ORR activity results employing V^{4+}/V^{5+} of different ratios as shown in Fig. 1. NPM catalyst reported here is synthesized dispersing the water soluble VO_2^+ and VO^{2+} ions at required ratio on carbon black surface by a novel freeze drying method. Subsequently metal ion loaded carbon black is subjected to high pressure pyrolysis along with melamine as nitrogen source.

This study aims at,

1. Optimizing the vanadium loading and V^{4+}/V^{5+} ratio
2. Optimizing the pyrolysis temperature
3. Vanadium melamine complex made at various pH and its effect on ORR activity
4. Estimation of catalytic site density of NPM catalyst by complexing with ligands such as EDTA.

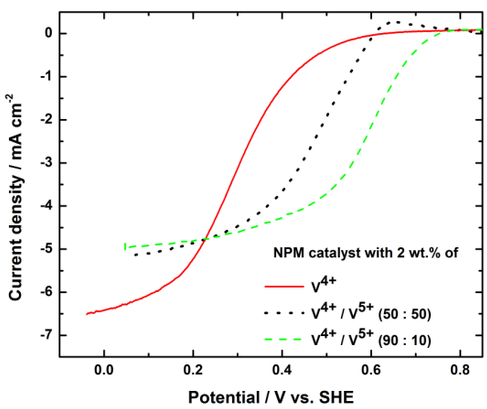

Fig. 1 *Effect of V^{4+} to V^{5+} ratio on ORR activity of vanadium based NPM catalyst in 1N H_2SO_4 at 25°C, 1600 rpm.*

References:

[1]. Y. Wang, K. S. Chen, J. Mishler, S. C. Cho and X. C. Adroher, *Applied Energy*, **88** (2011) 981-1007
[2]. M. Lefevre, E. Proietti, F. Jaouen and J. P. Dodelet, *Science*, **324** (2009) 71 - 74