OXYGEN REDUCTION REACTION ON Pd NANOPARTICLES SUPPORTED ON NOVEL MESOPOROUS CARBON MATERIALS

Madis Lüsi[1], Heiki Erikson[1], Kaido Tammeveski[1], Jose Solla-Gullón[2], Juan M. Feliu[2]

[1]*Institute of Chemistry, University of Tartu, Ravila 14a, 50411 Tartu, Estonia*
[2]*Instituto de Electroquímica, Universidad de Alicante, Apartado 99, 03080 Alicante, Spain*
e-mail of presenting author: madis.lusi@ut.ee

Three mesoporous nitrogen-doped carbon support materials were studied and compared to Vulcan carbon in 0.1 M KOH and 0.5 M H_2SO_4 for oxygen reduction reaction (ORR) using the RDE method. These support materials were loaded with Pd nanoparticles synthesized using citrate method and the average particle size was 3.9 ± 0.6 nm. Particle sizes were counted from TEM images. Three different loadings were studied on these support materials between nominal 20-40% Pd. Mesoporous support materials were provided by Pajarito Powder with specific surface areas of 730 $m^2\ g^{-1}$ for ECS-003604, 730 $m^2\ g^{-1}$ for ECS-004201 and 820 $m^2\ g^{-1}$ for ECS-004601 according to the producer. The ECS-004201 support had larger mesopores (15-50 nm) compared to ECS-004601 with higher amount of smaller mesopores (less than 15 nm). However, ECS-003604 is also Nb-doped. From TEM images (Fig. 1.), we can observe that Pd catalyst is less agglomerated on 40% Pd/ECS-003604 than on 40% Pd/Vulcan, which shows that the support material is enabling higher dispersion of Pd nanoparticles in comparison to Vulcan carbon. This result was also consistent with CV studies, where a positive shift of the PdO reduction peak of Pd/Vulcan was observed suggesting agglomeration. These two materials were also compared in single cell anion exchange membrane fuel cell experiment where ~1.5 times increase in peak power density was observed when switching the Pd catalyst support from Vulcan carbon to ECS-003604. Rest of the catalysts were compared using the RDE method, where in alkaline the activity differences between materials were less noticeable, in acidic media Pd on ECS-004201 showed the highest ORR activity. Obtained Pd/C catalysts showed excellent electrocatalytic activity with predominant pathway being 4-electron reduction of oxygen.

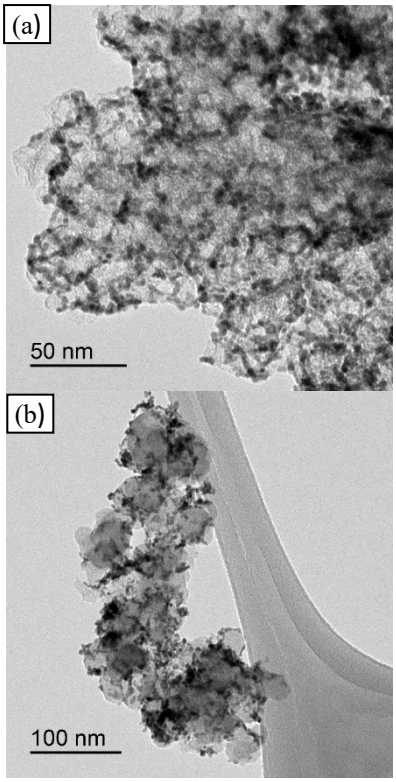

Figure 1. TEM images of (a) ECS-003604/40 and (b) Vulcan/40.

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks