

Organometallic complexes and chalcogenides are developing as alternative materials of platinum based electrocatalyst, and catalytic activity is closing to precious metal electrocatalyst. However, these materials have still some problems for durability and others. We have been studying 4<sup>th</sup> and 5<sup>th</sup> transition metal oxide base materials as a stable electrocatalyst since 2000, and the onset potential of Ta, Zr, Nb, and Ti oxide based materials achieved to ca. 1.0 V vs. RHE which is close to the platinum. The active site of these materials should be oxygen defect. In order to develop them as alternative material of platinum, volumetric activity and durability should be improved. [1, 2]

In this study, electrochemical stability of Ta-CNO has been investigated to evaluate the durability of these materials. Pt/C, which is conventional electrocatalyst of PEMFC, dissolves and sinters under potential cycling which simulates fuel cell operation, and degradation is enhanced at higher potential. On the other hand, particle coarsening could not be detected for Ta-CNO with ca. 50 nm of particle diameter, and the rest potential which was ca. 1.0 V vs. RHE was the most stable, and both lower or higher potential from the rest potential showed larger degradation. The potential cycling enhanced the degradation, and the behavior of degradation was almost the same to the conventional Pt/C (TEC10E50E, TKK, Japan) under rectangular wave between 0.6 and 1.0 V vs. RHE. These characteristics would be feasible for an alternative material of Pt/C.

#### References

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### HIGHLY STABLE POROUS ULTRA THIN WALLED PLATINUM NANOTUBES AS A FUEL CELL CATALYST

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#### Abstract

The need for highly efficient and low emission energy conversion devices has attracted attention towards fuel cells world over, but high catalyst costs

and poor durability prevent this application from being a viable solution for energy conversion. Nano-architectures such as nanotubes and nanowires are promising candidates to address several of the catalyst's facing issues. Traditional catalysts based on dispersed nanoparticles supported on carbon, suffer from particle agglomeration and support corrosion [1]. Nanotubes in particular, due to small diameters and large surface areas, have the potential to minimize most of the agglomeration mechanisms, and yet achieve high noble metal utilization [2]. In addition, freestanding nanotubes can be used as unsupported catalyst, thus eliminating catalyst's deactivation by support corrosion.

In this study we demonstrate the inherent advantages on the use of pure noble metal nanotubes that are ought to provide a high surface area and, due to its dimensions, have also the potential to prevent secondary agglomeration processes, thus increasing the fuel cell's life time. Electrochemical active surface area measurements and an accelerated durability procedure done by voltammetric cycling shows that the created noble-metal nanotube architecture posses a comparable available active area to dispersed nanoparticles but gratefully enhancing the stability under the environment normally found on fuel cells. The reported methods to produce noble metal nanotubes have commonly relied on external reducing agents, requiring extra purification steps, or galvanic displacement with the help of additives to improve the homogeneity of the nano-structure, but also leading to thicker walls [2-3]. We present a simple one-pot synthesis method to create platinum nanotubes by galvanic displacement between silver nanowires and platinum precursor without external additives at room temperature. The produced platinum nanotubes show uniform morphology, having diameters on the 50-100 nm range and with wall thickness of only 2 nm. The overall method has intrinsic scale-up applicability; based on the electrochemical potential's of the involved reactants thus self-limiting the process and minimizing undesired growth.

#### References

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