Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Bio-Inspired Synthesis of α-Ni(OH)$_2$ Nanobristles on Various Substrates and Their Applications

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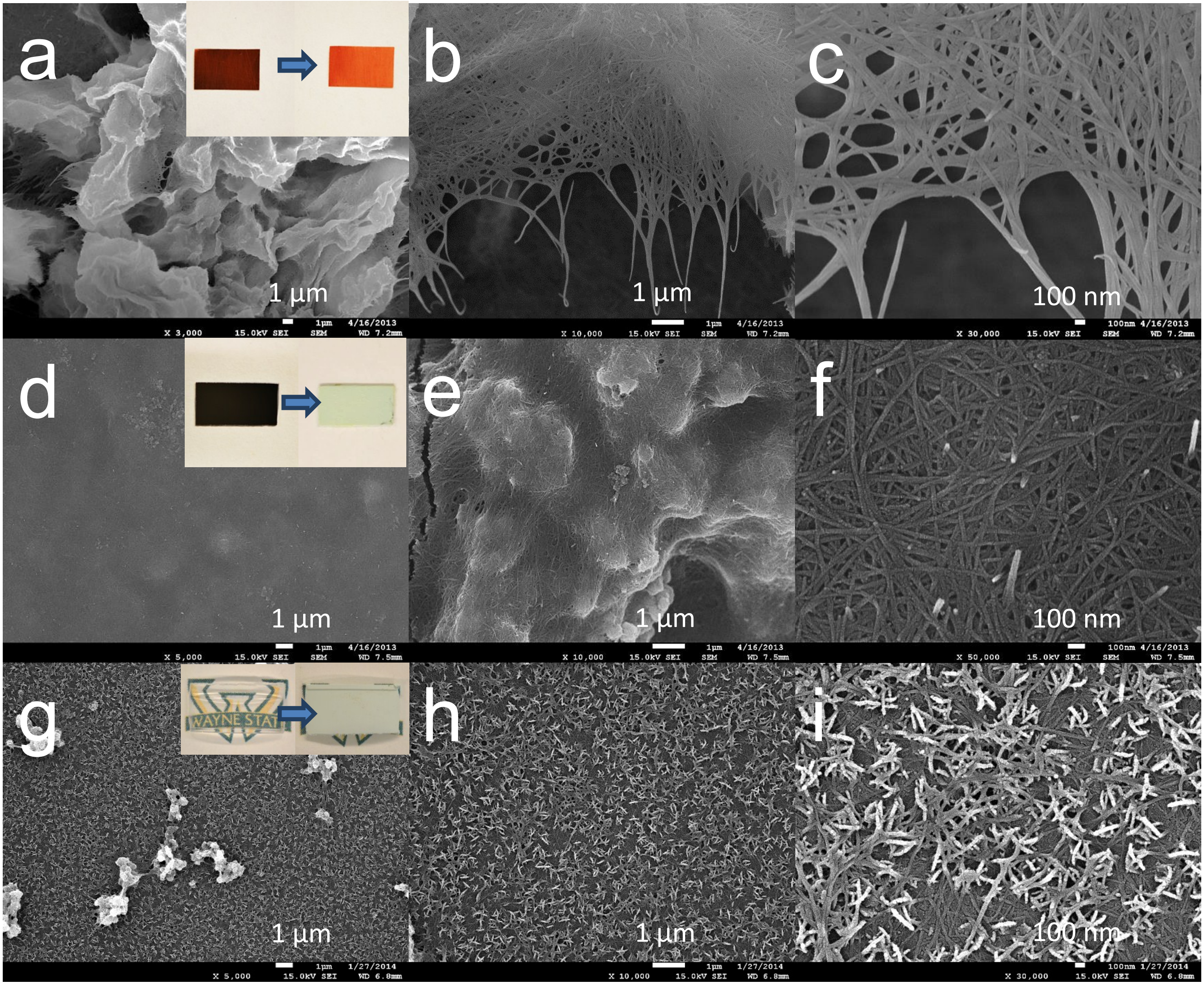


Figure S1. FESEM images of as-deposited α-Ni(OH)$_2$ nanobristles grown on various other substrates at different magnifications: (a, b, c) on Cu foil, (d, e, f) on silicon wafer, (g, h, i) on PET plastic. The inserts are the optical images of the corresponding substrates to demonstrate the color change before and after coating with α-Ni(OH)$_2$ nanobristles by membrane-assisted synthesis.

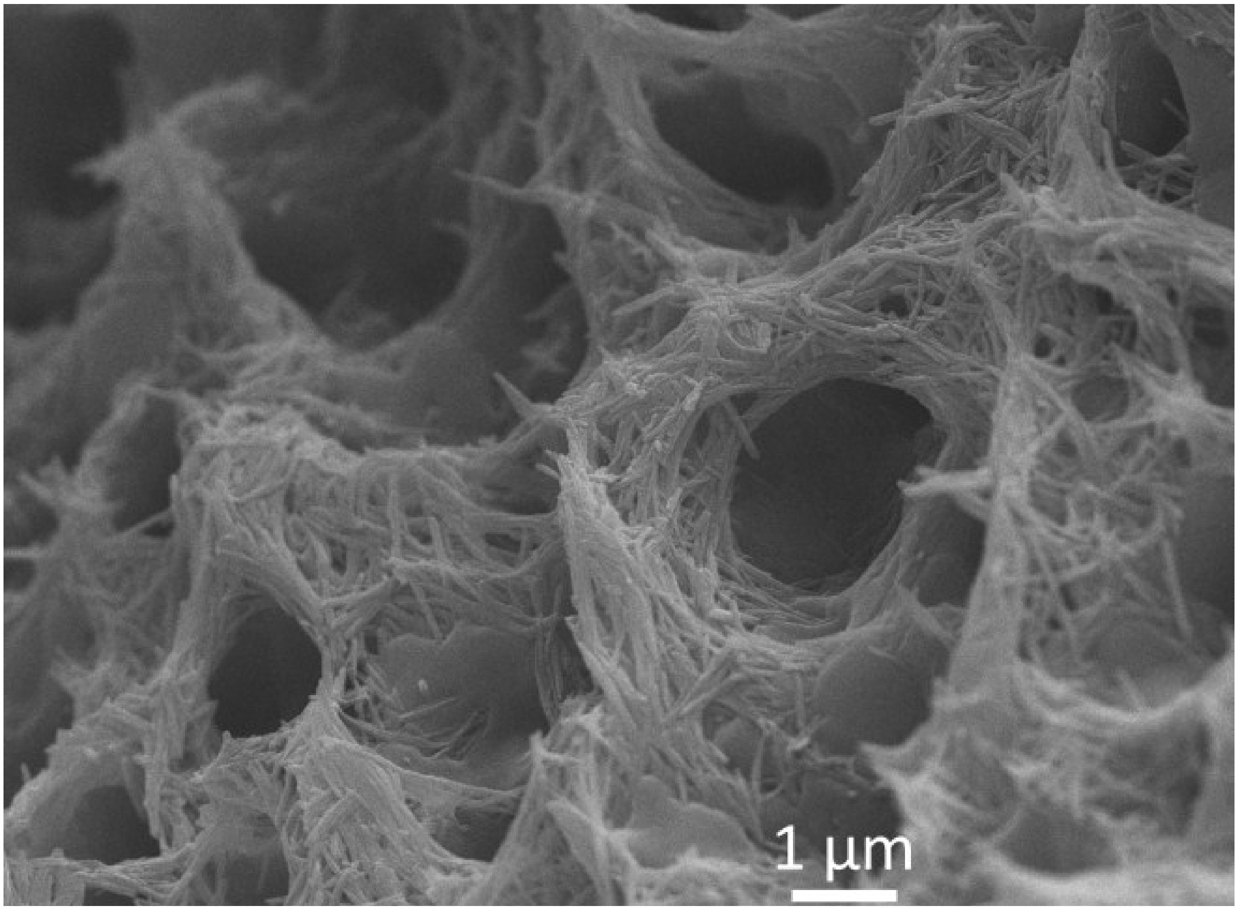
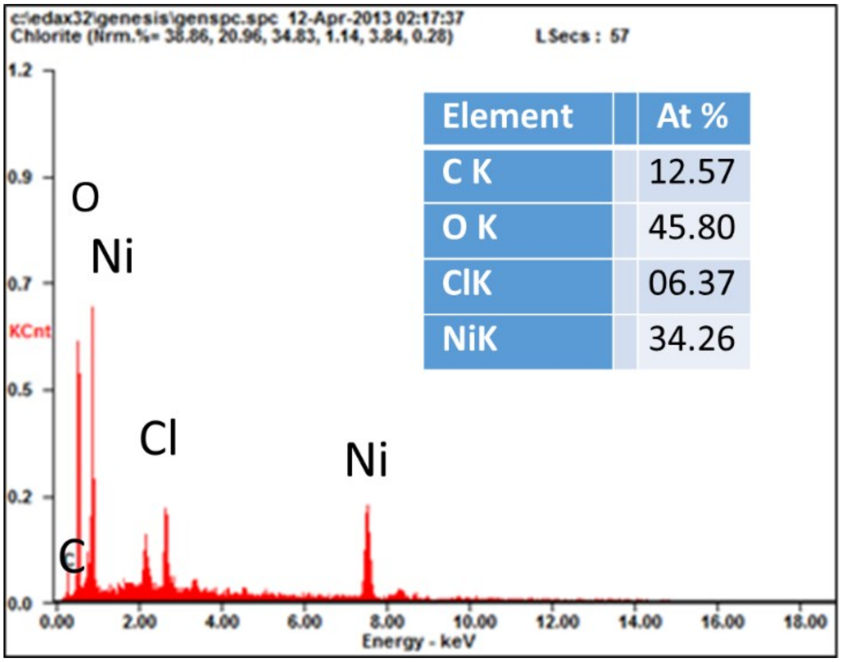


Figure S2. FESEM image of the surface of α-$Ni(OH)_2$ electrodes after 1000 cycles of electrochemical test as an electrode for supercapacitors.



Element	At %
C K	12.57
O K	45.80
ClK	06.37
NiK	34.26

Figure S3. EDS analysis of α-$Ni(OH)_2$ nanobrisltes showing the presence of Cl^- anions intercalated.

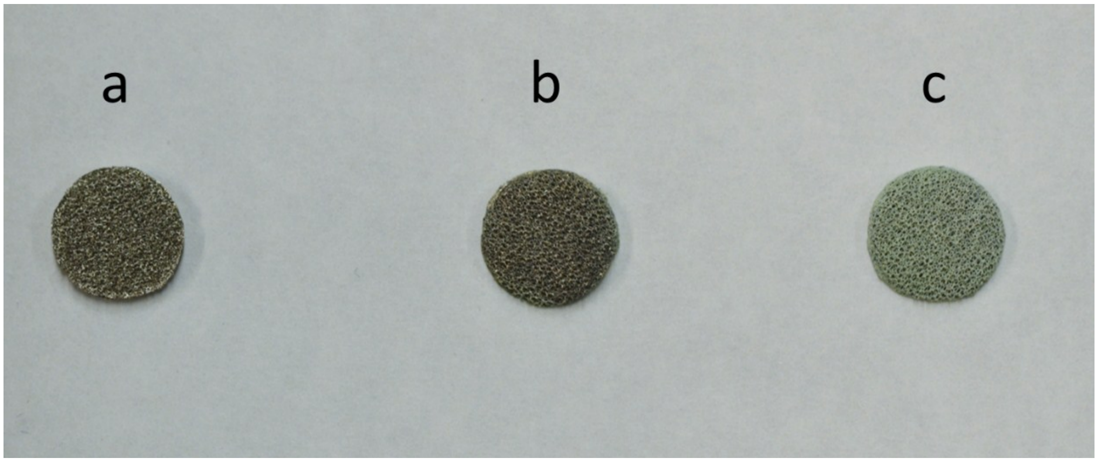


Figure S4. Optical images of Ni foams: a piece of (a) bare foam, (b) foam after reaction without the presence of CTAB, (c) foam after reaction in the chamber with 5 mM CTAB, indicating the importance of CTAB for growth of α-$Ni(OH)_2$ nanobrisltes on Ni foams.

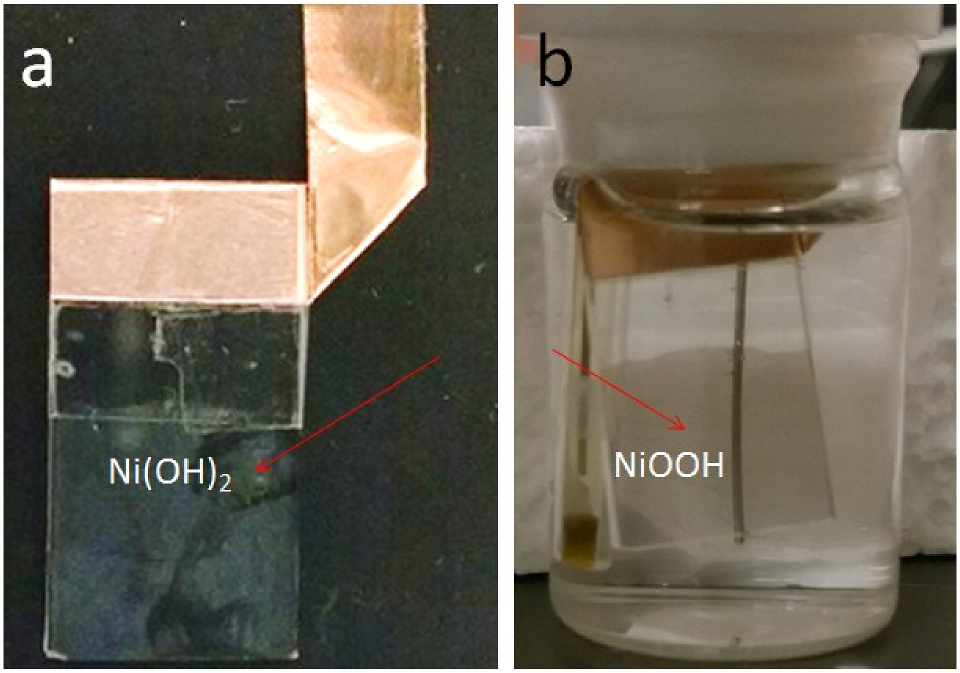


Figure S5. The optical images showing the color of (a) the as formed $Ni(OH)_2$ nanostrucutres on ITO glass with light green in color, and (b) electrochemically converted into NiOOH with light brown in color, suggesting another potential application could be electrochromic devices.

The reversible reaction involved for the color change could be $Ni(OH)_2 + OH^- \leftrightarrow NiOOH + H_2O + e^-$.[1] $Ni(OH)_2$ is green, while the NiOOH is brown in color.[2] Our exploration is very preliminary at this stage on electrochromic applications. However, the results show that (1) our method can form $Ni(OH)_2$ nanostructures on ITO glass and (2) color change can be tuned electrochemically. Our on-going effort is to improve our experimental systems and collect more results which will be report once available.

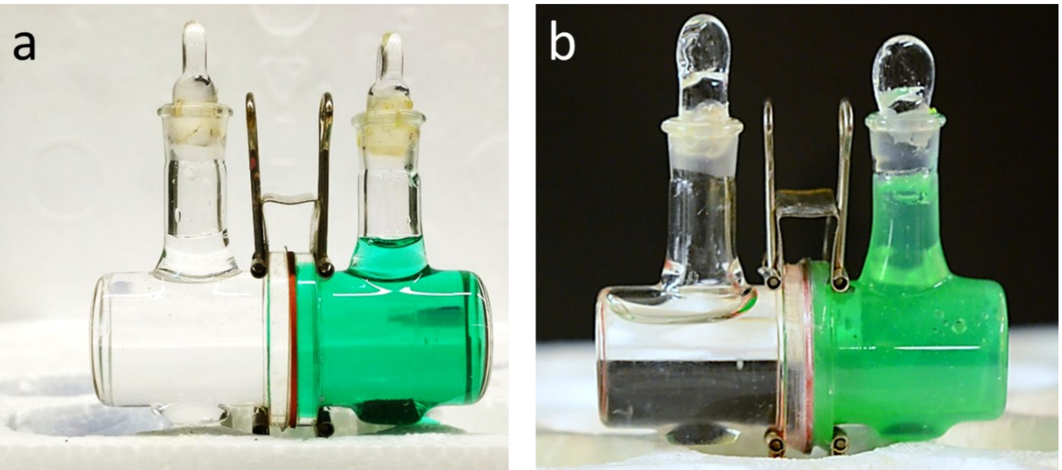


Figure S6. Optical images of the experimental chambers: (a) right after filled by the two solutions, and (b) after 5 days reaction at 50 ^{o}C. Note the osmosis effect leading to the volume increase in the left chamber of $NiCl_2$ solution. The Nafion exposed to NaOH would trapped any Ni cations transferred forming $Ni(OH)_2$ before the Ni cation could be transferred into the alkali chamber.

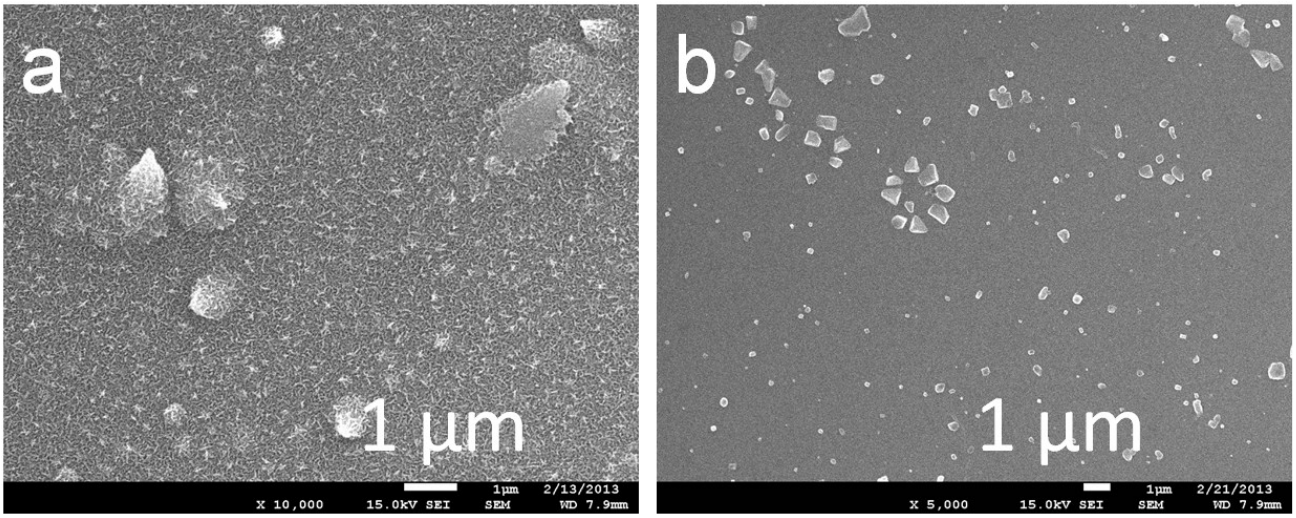


Figure S7. FESEM images of side of Nafion membrane facing different chambers: (a) side exposed to $NiCl_2$ solution, (b) side exposed to NaOH solution. The side of Nafion membrane exposed to $NiCl_2$ solution has nanobristles, in contrast to that of the side of Nafion membrane exposed to NaOH solution.

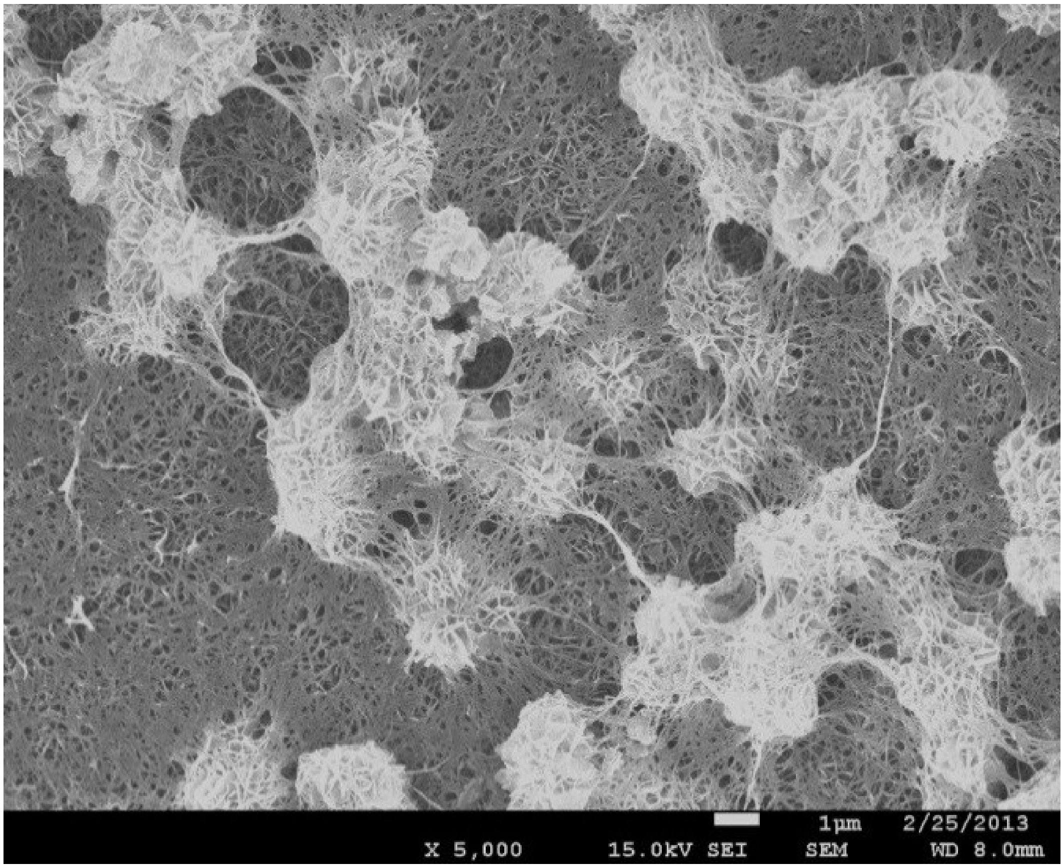


Figure S8. FESEM images of as-deposited $Ni(OH)_2$ on Nafion membrane in the absence of CTAB.

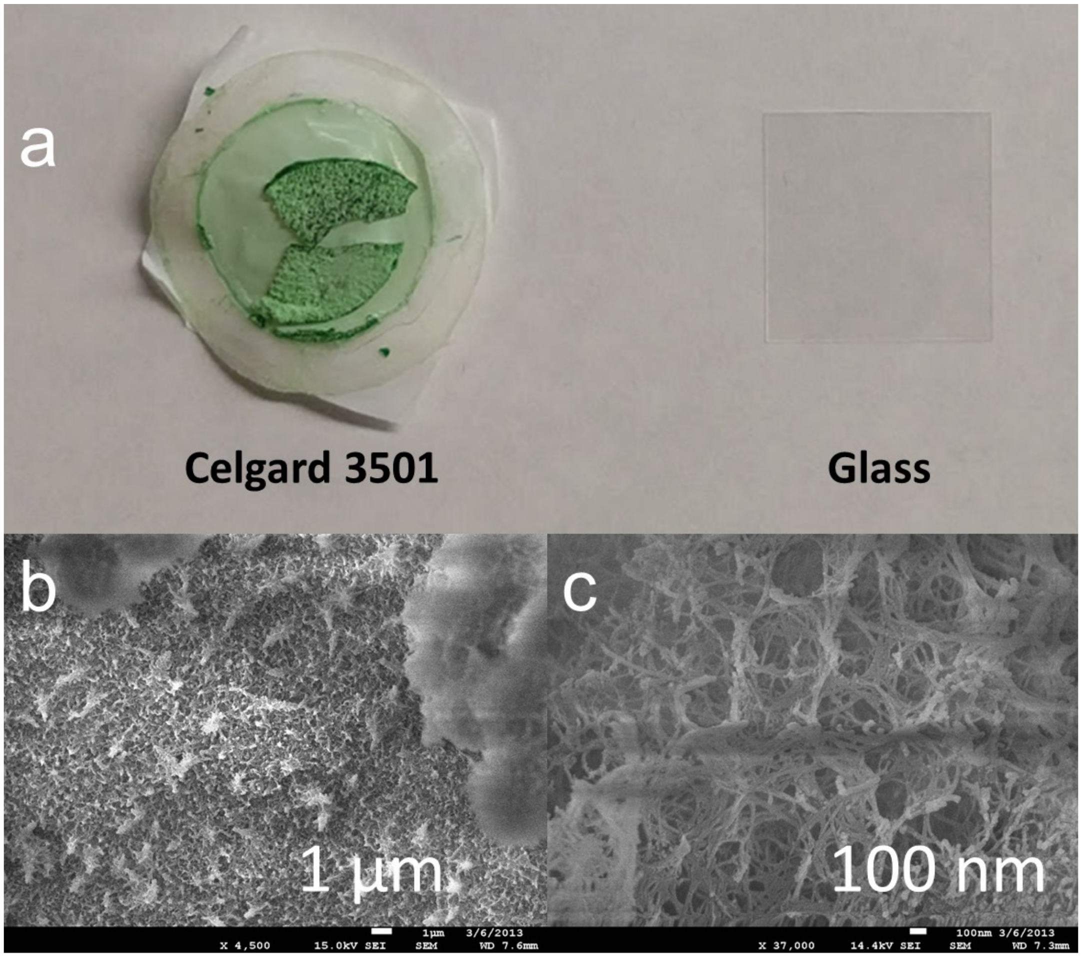


Figure S9. (a) Optical image of: (left) Celgard 3501 membrane with deposited $Ni(OH)_2$ and (right) glass inserted in the $NiCl_2$ solution chamber without any observed deposition. (b, c) FESEM images of nanostructured $Ni(OH_{)2}$ on Celgard 3501. We have tried Celgard battery separator, instead of Nafion membrane, under the same experimental conditions. Similar green color $Ni(OH)_2$ could form on the surface of the Celgard membrane (left). The deposited $Ni(OH)_2$ was thick and cracked upon drying. FESEM images show that the as formed $Ni(OH)_2$ is in the form of nanowires. However, there was no $Ni(OH)_2$ formed on the inserted glass (right). Therefore, Nafion is still needed in order to form $Ni(OH)_2$ nanobristles on the substrates. Our on-going effort is to gain better understanding on the formation mechanism.

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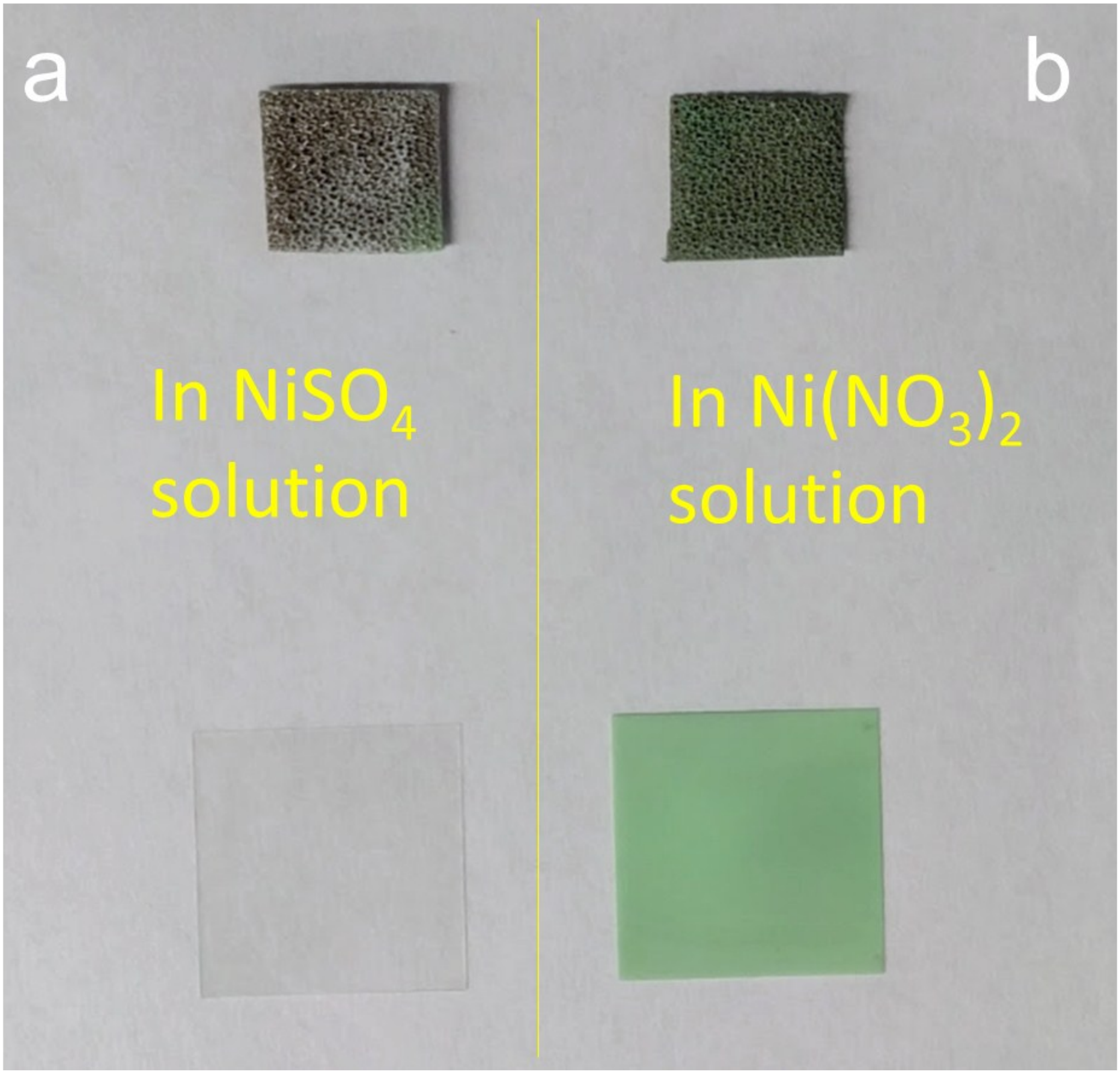

Figure S10. Optical images of as-deposited glass and Ni foam using different salts (a) $NiSO_4$ and (b) $Ni(NO_3)_2$ under the same experimental conditions. We have also carried out additional experiments to explore the effects of different anions. Instead of $NiCl_2$, we have also explored the use of $NiSO_4$ and $Ni(NO_3)_2$, while keeping all other experimental conditions unchanged. In the case of $Ni(NO_3)_2$, green color $Ni(OH)_2$ were formed and uniformly coated on both Ni foam and glass substrate (right). In the case of $NiSO_4$, no formation of $Ni(OH)_2$ on glass substrate was observed and the Ni foam was not uniformly coated with green color $Ni(OH)_2$ (left). It is known that the anions could significantly affect the structures of $Ni(OH)_2$ formed.[3] We are currently working on to gain better understanding. The coating on glass is very uniform in the case of using $Ni(NO_3)_2$ salt.

1. S. D. Min, C. J. Zhao, Z. M. Zhang, G. R. Chen, X. Z. Qian and Z. P. Guo, *J. Mater. Chem. A*, 2015, **3**, 3641-3650.
2. M. Z. Sialvi, R. J. Mortimer, G. D. Wilcox, A. M. Teridi, T. S. Varley, K. G. U. Wijayantha and C. A. Kirk, *ACS Applied Materials & Interfaces*, 2013, **5**, 5675-5682.
3. J. W. Lee, J. M. Ko and J. D. Kim, *J. Phys. Chem. C*, 2011, **115**, 19445-19454.