

Controlled Synthesis of Nanoporous Nickel Oxide with Two Dimensional Shapes through Thermal Decomposition of Metal-Cyanide Hybrid Coordination Polymers

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The urgent need for nanoporous metal oxides with highly crystallized frameworks is motivating scientists for discovering new preparation methods, because of their wide use in the practical applications. Recent work has demonstrated that two-dimensional (2D) cyanide-bridged coordination polymers (CPs) are promising materials and appropriate for this purpose¹. After calcination, 2D CPs can be transformed into nanoporous metal oxides sheets with a highly accessible surface area. Herein, this strategy is extended for the formation of 2D nanoporous nickel oxide (NiO) with tunable porosity and crystallinity, using trisodium citrate dihydrate (TSCD) as a controlling agent². The presence of TSCD plays a key role in the formation of 2D nanoflakes by controlling the nucleation rate and the crystal growth³ (**Fig. 1a**). The nanoflake sizes gradually increase by increasing the amount of trisodium citrate dihydrate. In the absence of TSCD, the reaction is fast and more Ni species dissolved in the solution are present as free Ni²⁺, reacting immediately with [Ni(CN)₄]²⁻ and leading to small-sized Ni-based cyanide-bridged CPs particles with random morphology (**Fig. 1b**). With a reaction rate a thousand times slower, the conditions are perfect to trigger an orientated crystal growth. After heating the as-prepared 2D CPs in air, nanoporous NiO can be obtained. During this thermal treatment, organic units (-C≡N-) are completely removed, and only the metal content remains to take part in the formation of nanoporous NiO. The large fraction of metal centers can be utilized as metal sources, while the removable organic components via simple calcination can provide nanopores^{4,5}. In the case of large-sized 2D CP nanoflakes, the original 2D flake-shapes are almost retained, even after thermal treatments. When used as an electrode, the pure nanoporous NiO sheets show a specific capacitance 3.5 times higher than the other samples, making such material an excellent candidate for supercapacitors applications.

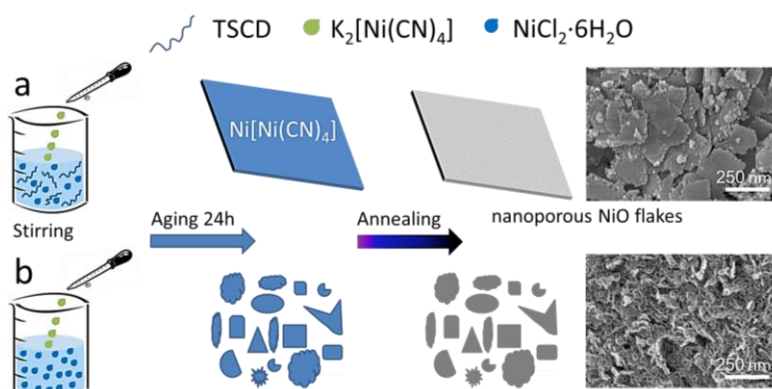


Figure 1 shows the controlled synthesis of nanoporous NiO flakes in the presence of TSCD (a) and the collapsed and crystallized NiO in the absence of TSCD (b).

Reference:

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