





Schematic of sample preparation and transmission electron microscopic (TEM) studies. **a** Synthetic procedure of the Ru-NC-*T* samples. Te NWs denotes tellurium nanowires, Te@MF refers to tellurium nanowires with a melamine–formaldehyde resin shell, Ru-MF indicates the incorporation of ruthenium precursors into Te@MF, and Ru-NC-*T* signifies Ru,N-codoped carbon prepared by pyrolysis of the Ru-MF nanowires at different temperatures. **b–d** Representative TEM images of Ru-NC-800 at different magnifications. Scale bars are **b** 500 nm, **c** 50 nm, and **d** 5 nm. **e** High-angle annular dark-field scanning TEM image of the red area of **c**. The scale bar is 20 nm. **f** Cross-sectional elemental distributions by line scans along the red line in **e**. The colors of the elemental maps of C, N, O, Te, and Ru correspond to those in the line scan spectra. Scale bars are all 20 nm. **g** A zoom-in of **e**, where red arrows signify ruthenium single atoms. The scale bar is 1 nm

## APPLICATIONS

Hydrogen generation by electrolysis

Hydrogen generation by electrolysis under alkaline conditions

## ADVANTAGES

Greater efficiency of hydrogen evolution reaction under alkaline conditions than commercially available Pt-C.

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Published Application	<a href="#">20210355588</a>	11/18/2021	2019-182

RELATED MATERIALS

- ▶ [Ruthenium atomically dispersed in carbon outperforms platinum toward hydrogen evolution in alkaline media](#) - 02/07/2019

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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- ▶ [Rapid Preparation of Electrocatalysts by Magnetic Induction Heating and Rapid Quenching](#)
- ▶ [Platinum Oxide Nanoparticles For Electrocheical Hydrogen Evolution Influence Of Platinum Valence State](#)
- ▶ [Catalysis Of The Hydrogen Evolution Reaction Using Ruthenium Ion Complexed Carbon Nitride Materials](#)