Scientists propose new method for direct fabrication of sub-10-nm nanopores

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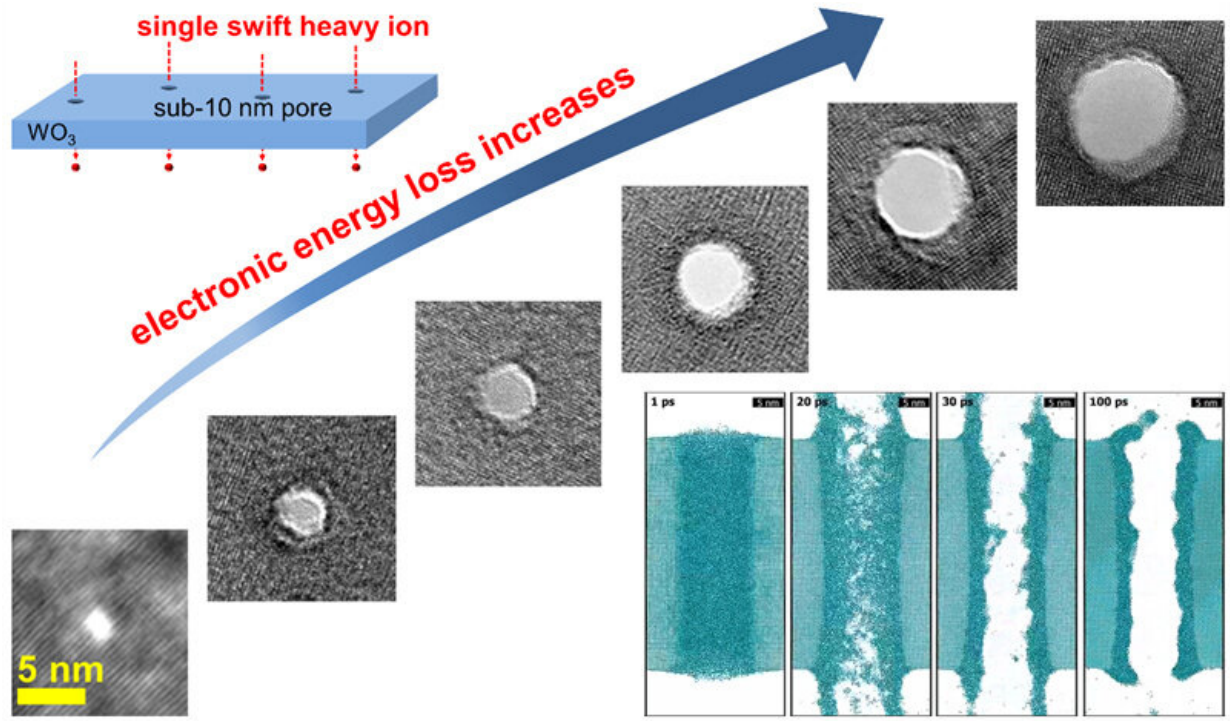

The sub-10 nm nanopores in the WO_3 nanosheets created using single swift heavy ions. Credit: Xu Lijun and Zhai Pengfei

Chinese scientists have proposed a new method for direct fabrication of sub-10 nm nanopores in WO_3 nanosheets using swift heavy ions. The results have been published in *Nano Letters*.

The study was conducted by the scientists at the Materials Research Center of the Institute of Modern Physics (IMP) of the Chinese Academy of Sciences (CAS) and their collaborator at the Joint Institute for Nuclear Research, Russia.

Fabrication of high-quality solid-state nanopores is of great importance to the applications of single molecule detection, nanofluidic devices and nanofiltration membranes. The most popular way to fabricate nanopores in inorganic films, such as SiN, SiO_2 and Al_2O_3, is to use focused ion or electron beams.

However, a feedback system or direct imaging is required when using this poring method, and only one single nanopore can be fabricated at a time, which limits mass production. Therefore, it is necessary to explore a new poring method that could create size- and density-controllable nanopores without any feedback system.

Based on the Heavy Ion Research Facility in Lanzhou (HIRFL), the scientists have demonstrated a direct poring method in WO_3 nanosheets using swift heavy ion irradiation.

In addition, they applied molecular dynamics simulations to explain the underlying mechanism. It was found that the viscosity and surface tension of the transient molten phase caused by swift heavy ions are the key factors for the formation of nanopores.

By selecting ions of different electronic energy losses, the scientists created nanopores with sizes from 1.8 to 7.4 nm in WO_3 nanosheets. They can control the density of nanopores by applying different ion fluences.

This new method, involving no chemical etching process, has the potential for wide application. It paves the way to fabricating solid-state

nanopores in materials with a low viscosity and surface tension using swift heavy ions, and provides new insights into the latent ion track formation in solid materials.

More information: Lijun Xu et al, Direct Fabrication of Sub-10 nm Nanopores in WO3 Nanosheets Using Single Swift Heavy Ions, *Nano Letters* (2023). DOI: 10.1021/acs.nanolett.3c00884

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