Expanding the capacity of hydrogen engines and solar cells with mesoporous nickel

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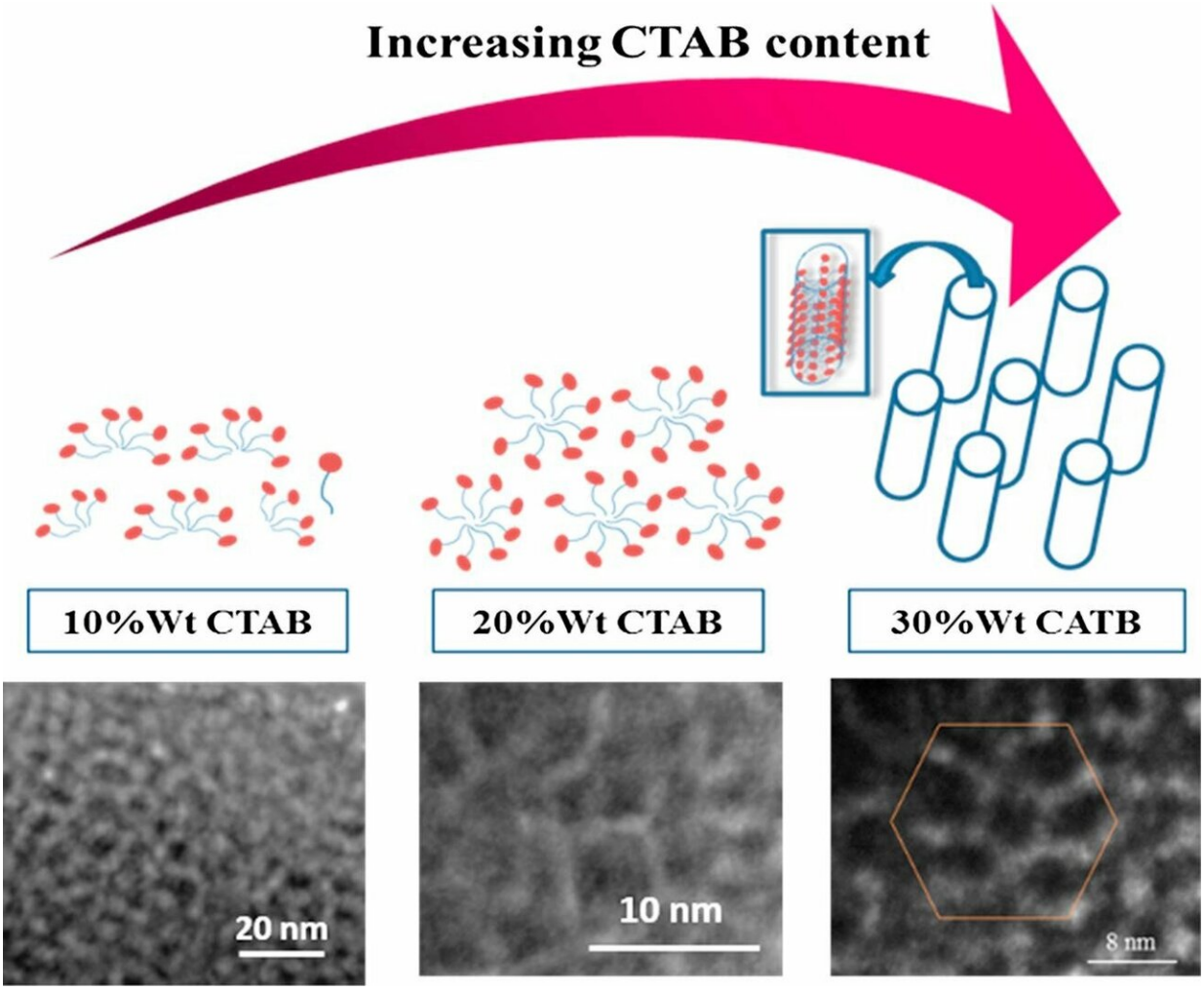

A schematic illustration of the formation of spherical and hexagonally arranged rod-like micelles at different concentrations of CTAB. Credit: FEFU

Scientists of the Far Eastern Federal University (FEFU), together with Russian and foreign colleagues, developed samples of nickel mesoporous film structures, which have a useful surface area up to 400 time greater than their solid analogue. This new material can be used in many energy-saving applications. The research results are published in *Applied Surface Science* journal.

According to Alexander Samardak, an associate professor of the Computer Systems Department at the School of Natural Sciences of FEFU, the creation of magnetic porous systems is an up-and-coming field, which is yet poorly studied. The structure of nanoporous materials is similar to a conventional sponge, which can accommodate significant volumes of substances. Thus, the useful surface area of the sponge is much larger than its size.

"The pores we obtained are very small, four to five nanometers, but thanks to them the total surface area of the material is increased 400 times. These unique properties grant the wide potential application of the material. Using such materials, one can create filters for cleaning and adsorption of ultrafine magnetic particles, media for storing substances, in particular, for hydrogen engines, where fuel storage cells are needed. In the future, they may be applied in the production of solar and lithium-ion batteries, in nanoelectronics and the automotive industry," said Alexander Samardak.

The unique material is obtained via electrodeposition of nickel particles on an artificial framework of a surfactant (SAS), which gives a structure of nanotube array composed by micelles. After electrodeposition, the framework dissolves in water and leaves behind only mesoporous nickel. Scientists have determined that when using a certain concentration of surfactants (30 weight percent), the nickel frame structure does not grow randomly, but in the form of hexagonally ordered nanotubes. This unique feature was observed by high resolution transmission electron

microscope operated by Dr. Alexey Ognev from FEFU. This opens up additional possibilities for this material application in the field of magnetic sensors and activators for nanoelectronics.

More information: Farzad Nasirpouri et al, Mesophase micelle-assisted electrodeposition and magnetisation behavior of meso-porous nickel films for efficient electrochemical energy and magnetic device applications, *Applied Surface Science* (2018). DOI: 10.1016/j.apsusc.2018.12.031

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