Mechanochemical Synthesized TiO_2 Nanostructures for Building Perovskite Structures

G. Kozma [1], Á. Kukovecz [1], Z. Kónya [1,2]

[1] University of Szeged, Department of Applied and Environmental Chemistry, Szeged, Hungary.
[2] MTA-SZTE Reaction Kinetics and Surface Chemistry Research Group, Szeged, Hungary.

Today, by the results of nanotechnology, materials properties can be manipulated on the nanometre range by different synthesis methods. Titan-dioxide has difficult production process but beneficial properties, that's why long has been the focus of research. By the preparation process of Horváth et al. TiO_2 nanowires have been made from nanotubes. The typical length was around 5 μm with 50-100 nm width. However, the mechanical stability of the nanowires studied, we found that using different milling energies different titanate structures are obtained. For grinding a planetary ball mill type Fritsch Pulverisette-6 was used with different materials milling drum. We found that by high energy milling the fibrous morphology damaged quickly to nano-sized particles, but by increasing the milling time crystallization was observed so the presence of anatase and rutile was detected.

On the other hand, TiO_2 was prepared via mechanochemical process from its precursors. For this purpose, $TiCl_4$, Na_2CO_3 and NaCl were mixed in a stainless steel grinding drum. During the process the pressure and temperature was recorded using a GTM ("Gas-pressure and Temperature Measurement system") measuring head. In this process, high-energy milling was used and it was found that TiO_2 nanoparticles with anatase and rutile crystal structures were successfully prepared. Later trititanate nanotubes were synthesized from the material thus prepared by hydrothermal means.

For detailed characterization X-ray diffraction, electronmicroscopic technics and specific surface area were measured.

Keywords: TiO_2, mechanochemical, nanomaterial.

Acknowledgements: The work was supported by the János Bolyai Research Fellowship of the Hungarian Academy of Sciences BO/00835/19/7, and by the professional support of the New National Excellence Program of the Ministry of Innovation and Technology ÚNKP-20-5-SZTE-656.