R&D Studies on metal oxide-based nanoparticles: Structure dependent physical and chemical properties

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Metal oxide based porous nanomaterials are widely synthesized and used for several technological developments based on energy storage, catalytic chemistry, and medical applications [1-3]. In the present study, the newly designed MeOx (Me: Ce, Mn, Si, Ti) nanoparticles were prepared and structurally investigated in molecular, nanoscopic and microscopic scales by using several complementary experimental methods. The form factors for elliptical, core-shell oblate and fractal models were used in SAXS analyses (it can be shown in Figure 1) to characterize the morphologies. Thermal processes were activated at T= 410, 450 and 500 °C to investigate nanostructural properties. The focused targets with the present R&D studies were increasing the surface area of the nanoparticles and reaching the stabilized monodispersed morphologies and uniform distributions.

As a result of the study, it was obtained that, the size, shape, and distribution-controlled synthesizing processes are possible with thermal treatments. Especially, a critical temperature value of about 400°C is effective on the nanomorphologies of MnO2 particles. Ellipsoidal fractal units come together to form larger and more compact core-shell oblate shape nanoparticles. Electrochemical measurements were also performed by using a conventional three-electrode system to determine the physicochemical properties. So, it was obtained that, the larger electrochemical capacitance than the commercial electrolytic metal dioxides may be prepared with these nanoparticles.

On the other hand, it was also determined that the larger surface area and high porosity of the synthesized TiO2 nanoparticles besides their well determined monodispersed and uniformly distributed nanomorphologies may cause various immunomodulatory effects when they exposed to cells with the purpose of several biochemical and biophysical applications. The in-vitro and in-vivo examinations were also started on the determined nanoparticles made by choice according to their properties to investigate their potential usages in medical applications.

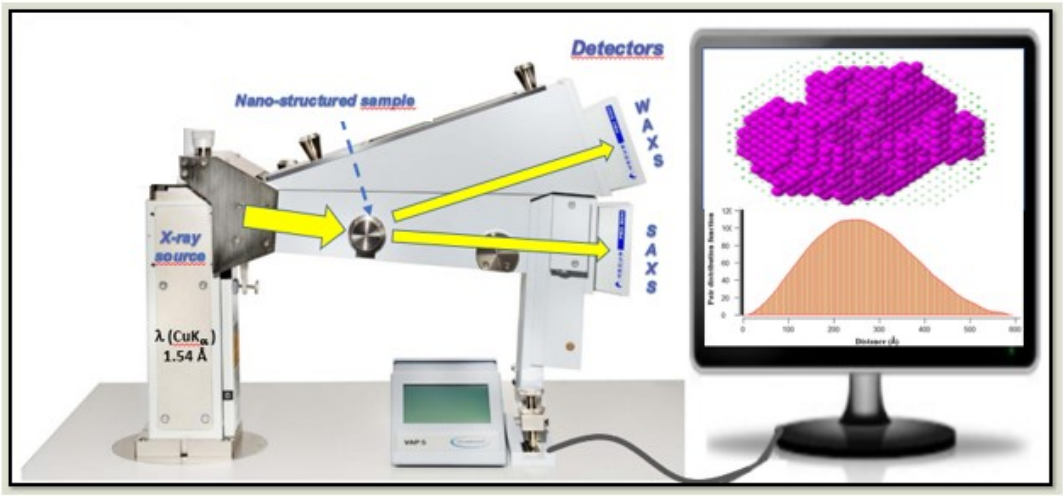

Figure 1. HECUS System 3 Small and Wide Angle X-Ray Scattering (SWAXS) schematic representation

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