PREPARATION OF DIFFERENT SHAPE METAL OXIDE MICRO- AND NANOSTRUCTURES BY GELATION OF OLIGOMERIC METAL ALKOXIDE CONCENTRATES

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Metal oxide ceramics are applied in wide range of high-tech applications like temperature resistant layers, high refractive index materials, photonics, transparent electrodes, abrasives, constructing materials etc. These applications are possible due to unique extreme properties of the materials. However, complications to prepare these materials in desired shape often limit their applicability. The problems are related to nature of these materials in bulk as they rather decompose at elevated temperatures than transform to moldable melts. The problems are usually overcome by using sintering of compressed powders. The technology has found wide industrial use as it enables to prepare complicated structures at rather low cost. Unfortunately, based on microcrystalline raw materials, that method is almost useless in order to prepare defined shape microstructures.

To overcome the limitations, metal alkoxide based sol-gel technology has been taken into use. Desired final shape structures are obtained as a result of gelation of sols in suitable molds as thin films or as jets pulled into air [1]. The method has many advantages like much lower heat treatment temperatures compared to powder sintering. In addition it is easy to dope the materials with different additives. Sol-gel process is also attractive as it is easy to scale it up.

Current presentation introduces the possibilities to use novel alkoxide based oligomeric precursors in order to prepare metal oxide structures. Precursor structure is clarified by IR, NMR, SAXS, AFM and other techniques. Analyses have proved that precursors contain short sterically stabilised oligomeric particles, which define elasto-viscos flow behaviour.

Combining the chemical processing like hydrolysis and polycondensation with mechanical manipulations like jet pulling, tape casting, micromolding etc, enables us to prepare the materials in wide range of shapes in nano and micro scale like nanofibres, nanosharp needles, microstripes on the surface, microtubes, self-standing membranes and others (Figure 1) [2-3].

AFM imaging revealed that obtained structures have surface roughness no more than 1-2 nm. Microtubular structures have gas resistance up to at least 200 atm. of He pressure applied inside the tube. At least down to 2-3 μm thickness (diameter), the structures have significant waveguiding properties [4].

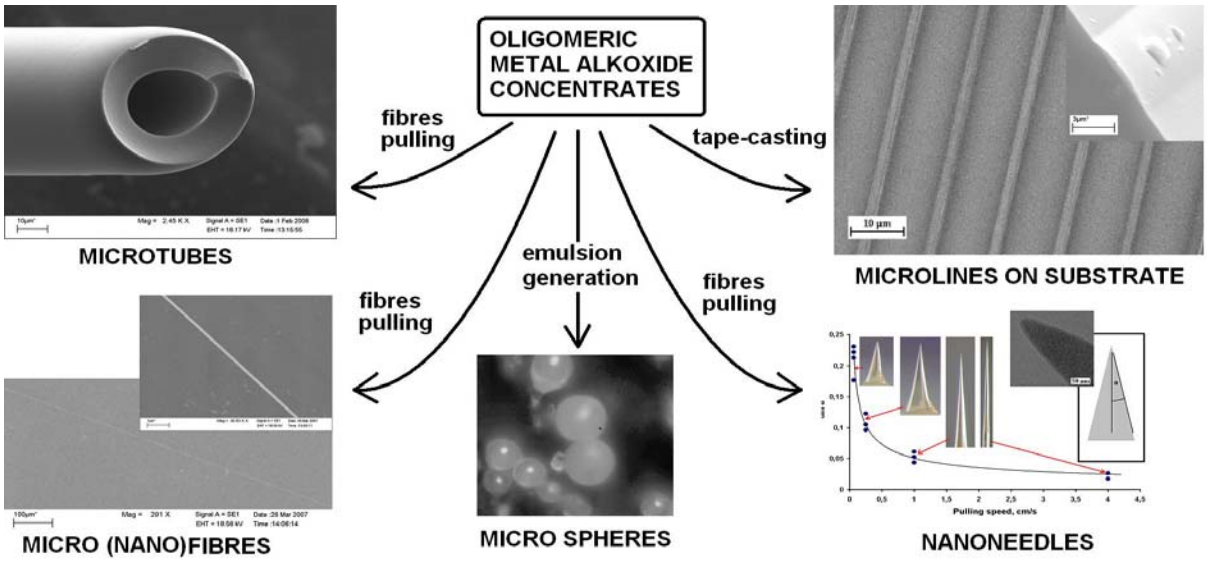

Figure 1. Different shape metal oxide structures prepared from metal alkoxide oligomeric concentrates.

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[4] paper in preparation