Oral PhD

Metal oxide fibers or micropipe preparation exploitation improving mechanism of metal alkoxide liquid threads

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If we need fibers with nicely circular, ellipsoidal, or even irregular cross-section geometry, we can use sol-gel technology.[1] Additionally, hollow fibers can also be prepared. M. Aizawa et al. [2] did embarks follow such structures, denoted as capillaries or microtubes, preparation methods. Curing processes affording transformation of liquid threads into solid material have achieved technological importance.

In our recent work [3,4,5] we using sol-gel transition (solidification; curing) of metal-alkoxide liquid threads for the preparation of the oxide ceramic fibers and microtubes. We started from fibers, designated their mechanical properties [3], and then modified the method for microtubes [4]. The method is founded on using precursors including of sub-crystalline 1-2 nm metal-oxo cores, disclosed as a product of reaction between metal-oxo-alkoxides and water. The cores without stabilizing shells are used as blocks to build up the walls of the tubes. The chemical process occurs as a self-assembly of particles, while released alcohol remains to fill the core of the tube and is removed later by evaporation. These experiments tender a solution to the technological problem in the preparation of high quality 10 to 100 µm diameter nanoceramic-microtubes.

This presentation is focusing on the collation of curing mechanisms for metalalkoxide-derived liquid threads. Likening the solidification of propoxide and butoxide precursors, we studied the mechanisms of the formation of fine metal oxide fibers or hollow microtubes. These microtubes are auspicious candidate material for catalyst carriers and microreactors, drug delivery, for microbattery applications [6]. If operating under extreme conditions (high pressure, temperature or plasma), also as pipes in different microfluidic systems [6].

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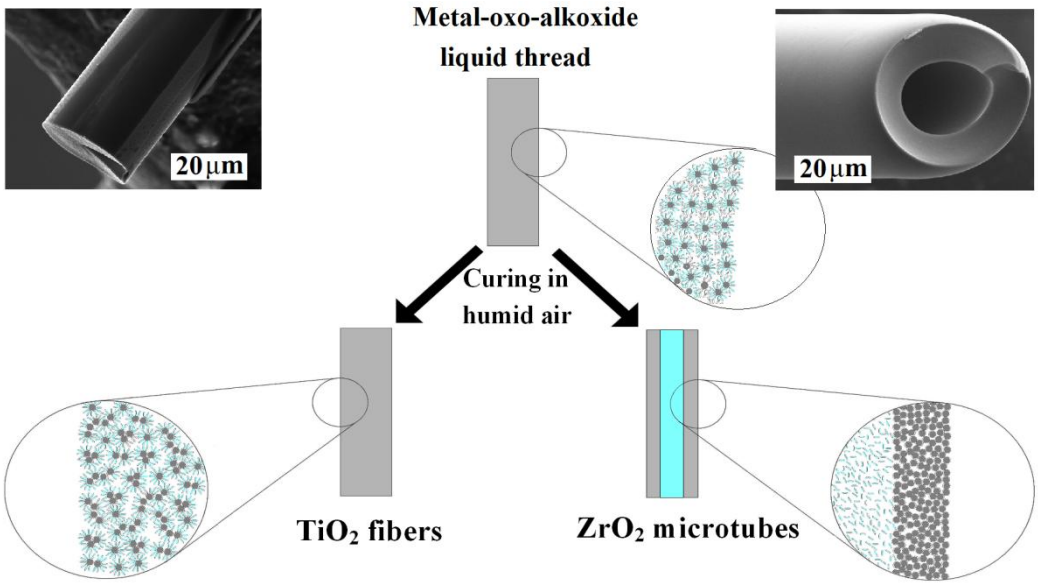

Figure 1. Curing process illustration for metalalkoxide precursors.

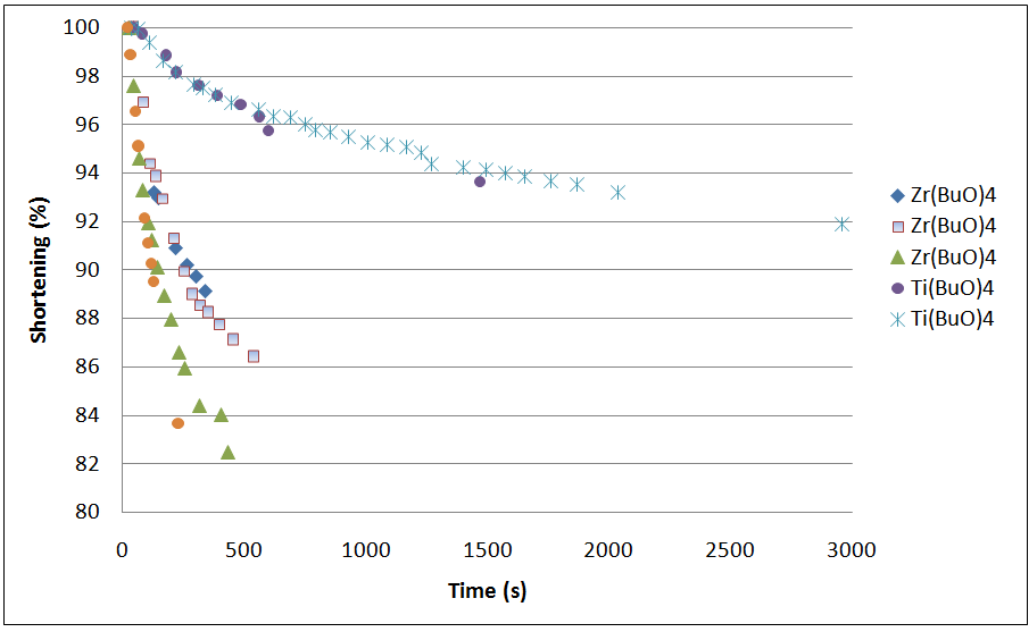

Figure 2. In laboratory atmosphere as-drawn $Zr(OBu)_4$ and $Ti(OBu)_4$ threads shrinkage of solidification is 30-50 % [6].