TFE4575: Chemical methods for thin film deposition

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Abstract

So abstract, wow!

Contents

1. Theory

1.1. Sol-Gel Synthesis Method

This subsection is based on chapter 3 of B. L. Cushing *et al.* review paper *Recent Advances in the Liquid- Phase Synthesis of Inorganic Nanoparticles* [1].

In general, sol-gel processing combines small molecules to form a solid material. This is done using a solution of precursors (the *sol*) that forms a network of bound molecules (the *gel*). Traditionally, sol-gel processing only referred to the hydrolysis and condensation of alkoxide based precoursors such as $Si(OEt)_2$ (tetraethyl orthosilicate), but today it refers to all processes using sol-gel. The sol-gel synthesis method can be divided into the following six distinct steps.

Step (1): The formation of a stable solution of the alkoxide or solvated metal precursor.

Step (2): The gelation that results in the formation an oxide- or alcohol-bridged network by polycondensation or polyesterification reactions. This dramatically increases the the viscosity of the solution.

Step (3): The aging of the cell, also known as syneresis. In this step, the gel network contracts and expulses the solution from the pores, and the reactions continue until the gel forms a solid mass.

Step (4): The drying of the gel where water and other volatile liquids are removed. This step is complicated because it fundamentally changes the gel structure. The drying process comprises of four sub-steps: (i) the constant rate period, (ii) the critical point, (iii), the first falling rate period, and (iv) the second falling rate period. The result is either termed a xerogel, if isolated by thermal evaporation, or an aerogel, if the solvent is extracted under supercritical conditions.

Step (5): Dehydration of the gel using high temperatures. This removes surface-bound M-OH groups, thus stabilizing against rehydration.

Step (6): The densification and decomposition of the gel. This makes the gel pores collapse, and all remaining organic species are volatilized.

1.2. Chemistry of the Sols

Using the sol-gel synthesis method, one can produce thin films. One example of such a film is BTO (Barium titanium oxygen), which can be made of a mixture of barium sol and titanium sol. The following paragraphs explains the components of these sols and what their functions are.

The barium sol can be made of a mixture of water, EDTA (Ethylenediaminetetraacetic acid), ammonia solution, barium nitrate, and citric acid.

1.3. Equipment Used

1.3.1. SEM

Scanning electron microscopes (SEM) are used for sample analysis, and

2. Methods

3. Results

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These are the results. Results are good. fgfdgd

Best results ever, am I right?!

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3.1. Optical Images

3.2. Profilometer

For the profilometer analysis, you should perform this at three different places on the sample. Make profiles from the edge of the sample and to the center.

3.3. Scanning Electron Microscope

Results should also include SEM and optical images of both samples. It may be that you need to coat the samples with a conductive coating (i.e. carbon or gold) for SEM imaging as barium titanate is not very conductive. Comment on whether or not you did this in your report. Since coating might be necessary, it is recommended that you do the profilometer and the optical analysis first, as coating will affect the roughness and the thickness of the sample.

At least two magnifications of each sample (for SEM and optical microscope) should be shown in the report. It is important to get one overview image, which shows the overall morphology of the film; and one closer image where you only focus on a small section to look at grain size, close-up of cracks and other potential surface artifacts.

4. Discussion

I think this. No this is much better. Every discussion ever.

5. Conclusion

To conclude, this is boring!

References

[1] B. L. Cushing et al. Recent Advances in the Liquid- Phase Synthesis of Inorganic Nanoparticles. Chem. Rev., 2004, 104 (9), 3893-3946, DOI: 10.1021/cr030027b.