

# An AFM study of nanoparticles arrangement with deposition time

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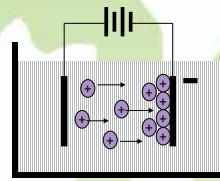


## INTRODUCTION:

- The assembly of YSZ nanoparticles obtained under hydrothermal conditions has been studied. YSZ colloids are 5-8 nm in size and spherical shaped, and they have been stabilized in the post reaction medium, avoiding the drying step between synthesis and shaping.
- Deposited powder is significantly less than 50% of that in suspension.
- The aim of this study is to characterize the film growth behavior and the gradient function of the aggregates using Atomic Force Microscopy (AFM).

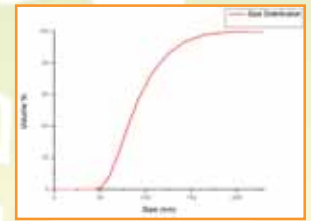
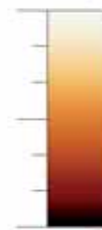
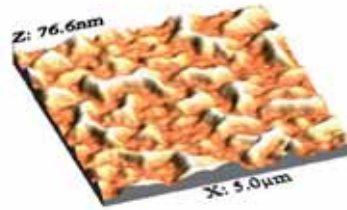
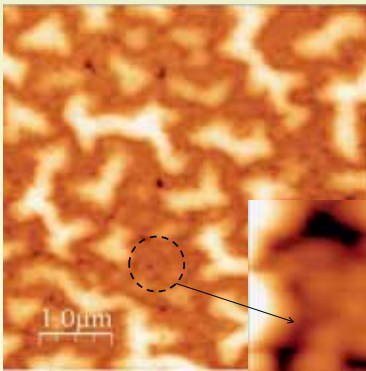
## ELECTROPHORETIC DEPOSITION:

EPD is a colloidal shaping method which comprises two main steps:



- **Electrophoresis:** in which charged particles suspended in a liquid medium migrate to the oppositely charged electrode under the action of an electric field.
- **Deposition:** in which the particles settle down on the electrode to form a strongly stuck and internally cohesive deposit.

## YSZ NANO-SPHERES



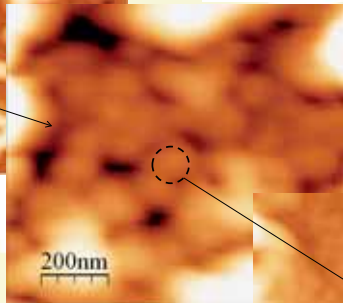
Film profile corresponds to the agglomerate size, consequently growth takes place layer by layer.

The size distribution shows that YSZ forms aggregates with sizes under 100 nm. The stability of the aggregate dispersion in the post-reaction medium is achieved after adding Polyethylenimine as stabilizer.

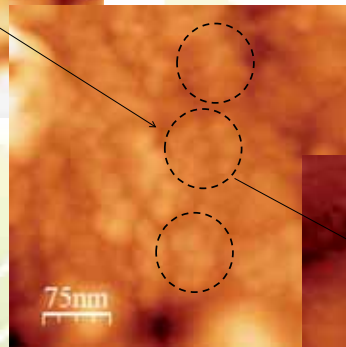
50% of the aggregates have sizes between 40 and 80 nm which correspond to the film profile. Smaller aggregates seem to be the first deposited particles.



YSZ deposited film in electro-polished steel



AFM topography reveals how YSZ particles arrange into aggregates

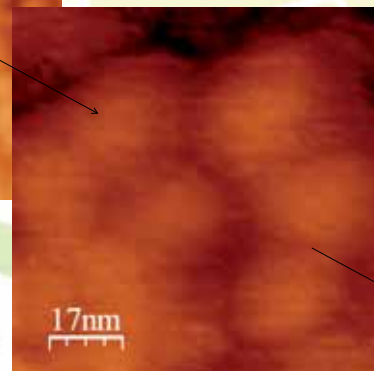
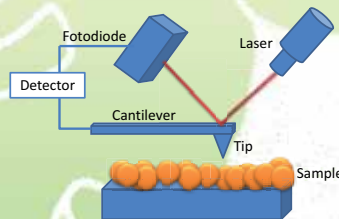


Growth behaviour of YSZ films can not be established by HR TEM, however micrographs verify YSZ aggregation after synthesis.

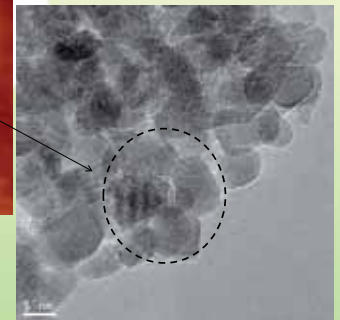
## Dynamic Measurement:

It's a no-contact mode of measurement useful to study topography of green bodies and soft samples, avoiding sample degradation.

The cantilever oscillated at a frequency near to resonance frequency. The tip interacts with the sample with Van der Waals forces, decreasing the resonance frequency of the cantilever, but the amplitude of the oscillation remains constant.



At higher magnification the hexagonal system packaging can be observed.



## CONCLUSIONS:

- Electrophoretic Deposition allows to obtain dense thin films.
- AFM is a useful tool to study the nanoparticles deposition behavior and its aggregation through the determination of the film topography evolution.
- Although the EPD theory does not predict it, smaller aggregates take shorter times to reach the substrate and deposit forming the YSZ film.