

Óbuda University

Doctoral School of Materials Sciences and Technologies

ELKH, Centre for Energy Research, Institute of Technical
Physics and Materials Science



Development and structural characterization of bioceramics

PhD student :

Maroua Houria Kaou

Supervisors:

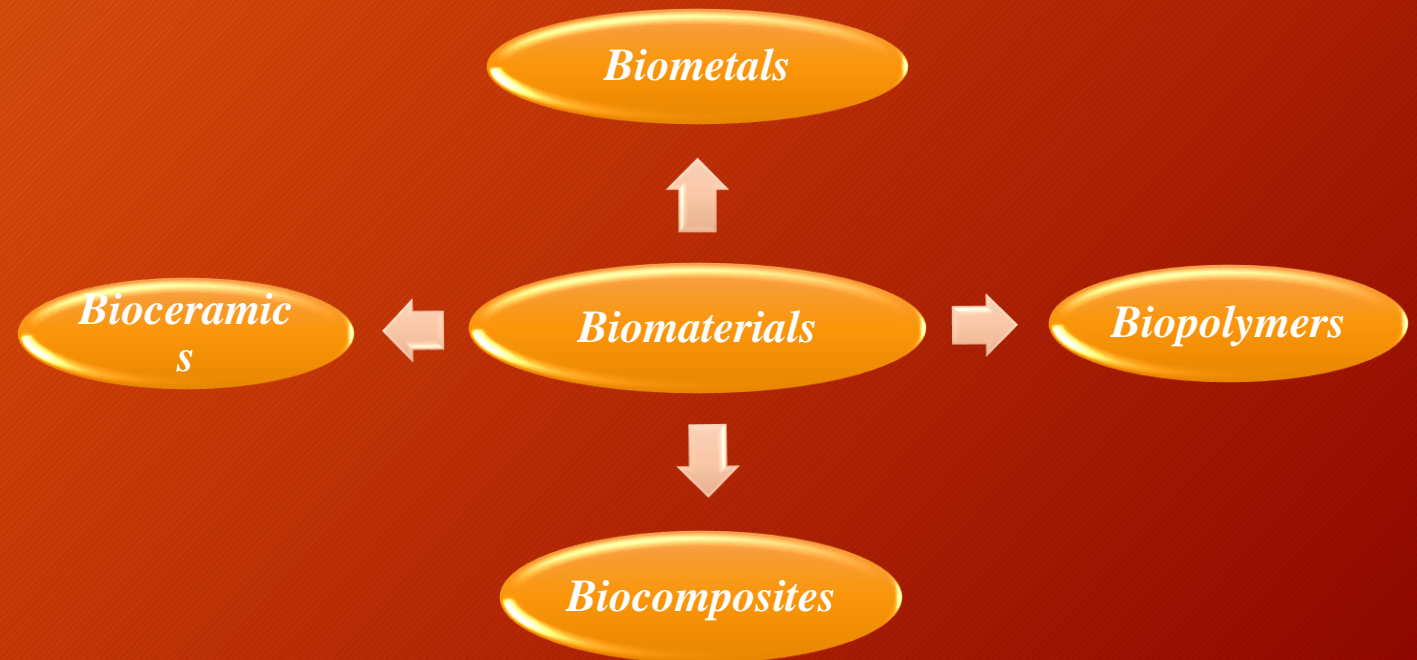
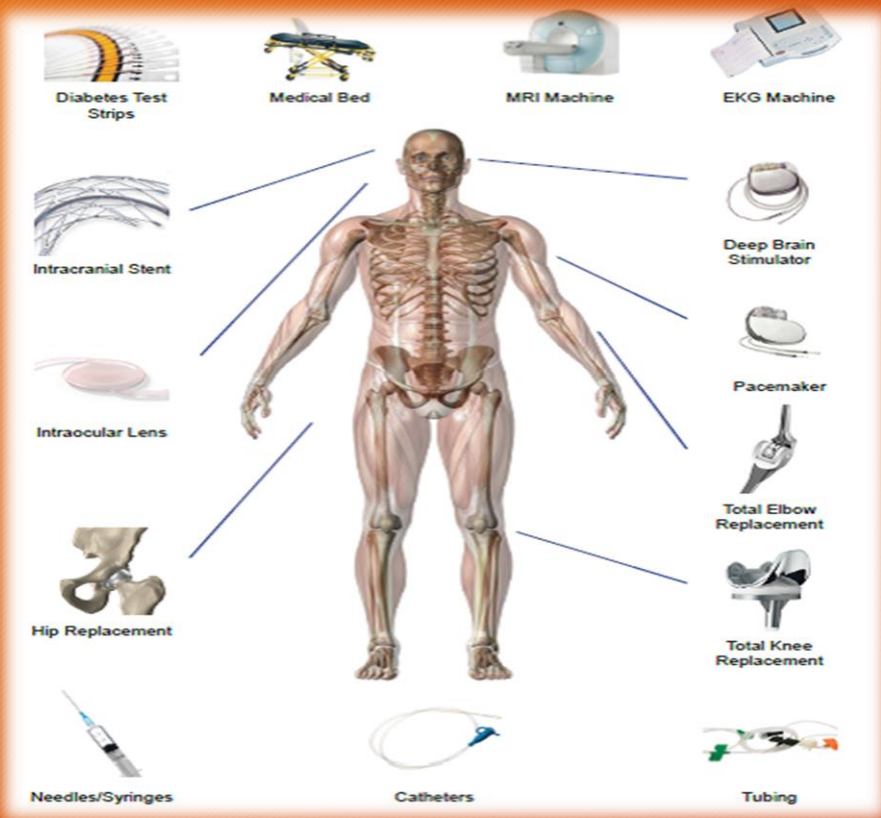
Dr. Csaba Balázs

Dr. Katalin Balázs

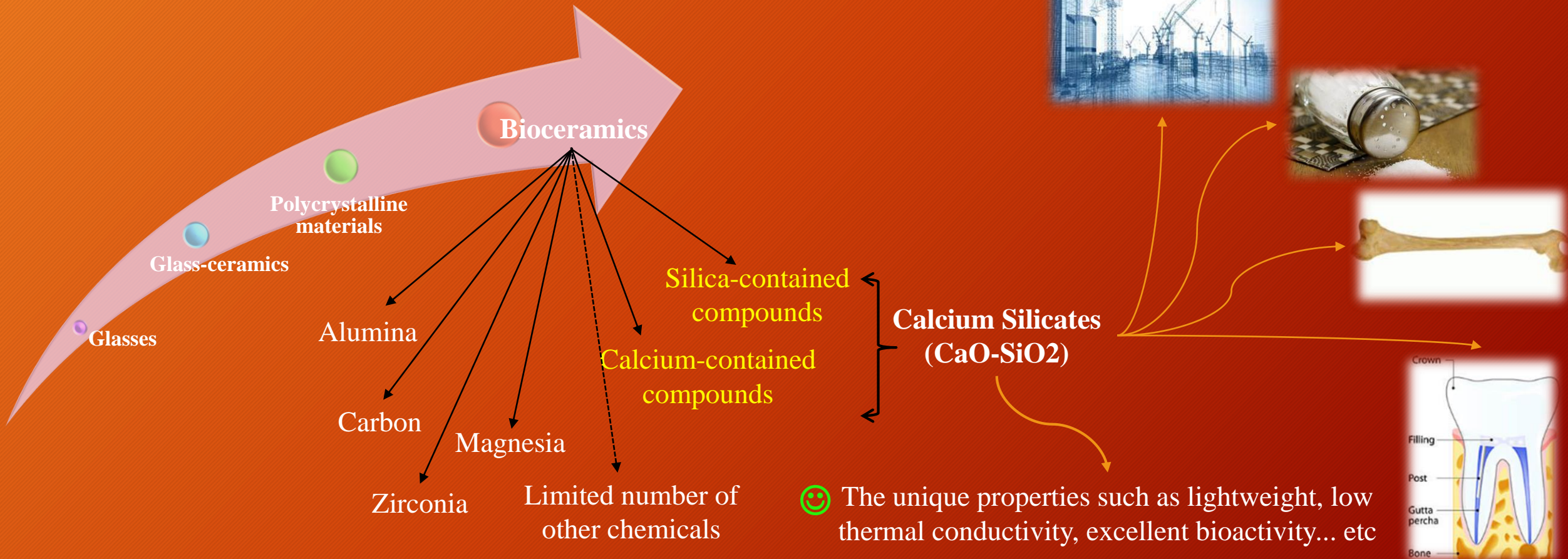
Recall on the previous semesters



😊 All implantable items must be prepared from a special class of **tolerable materials** → **Biomaterials**



Recall on the previous semesters



Calcium Silicates (CaO-SiO_2)



Different types of bioactive glasses have been developed and some have been already used in the clinic

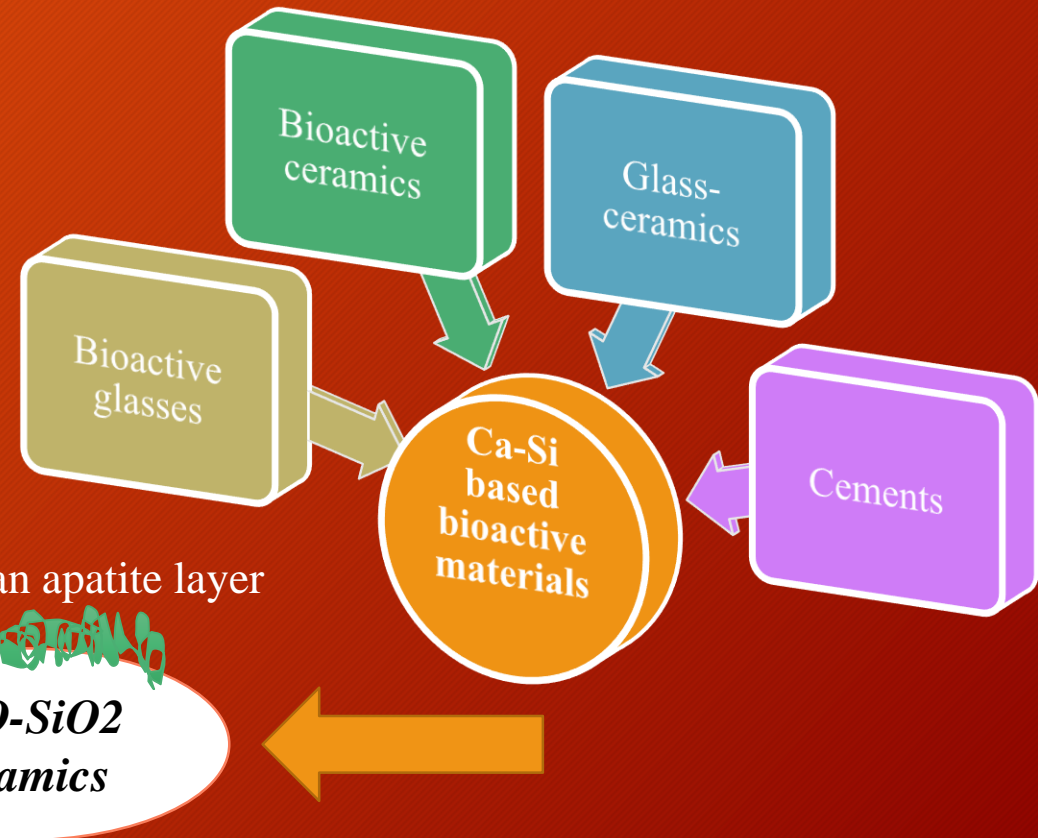
Glasses with this composition were able to bond to soft and hard tissues

Glass system of SiO_2 - CaO - Na_2O - P_2O_5

The beneficial effects of materials based on Ca-Si on inducing bone formation

Formation of an apatite layer

CaO-SiO_2 ceramics



Calcium Silicates (CaO-SiO_2)



Different parameters can affect and control the biological behaviors

Fabrication method

Composition

Precursors

Sintering temperatures



Starting materials preparation



Heat treatment in the air
(7h, 12h)



Calcium Oxide (CaO)



Silica gel

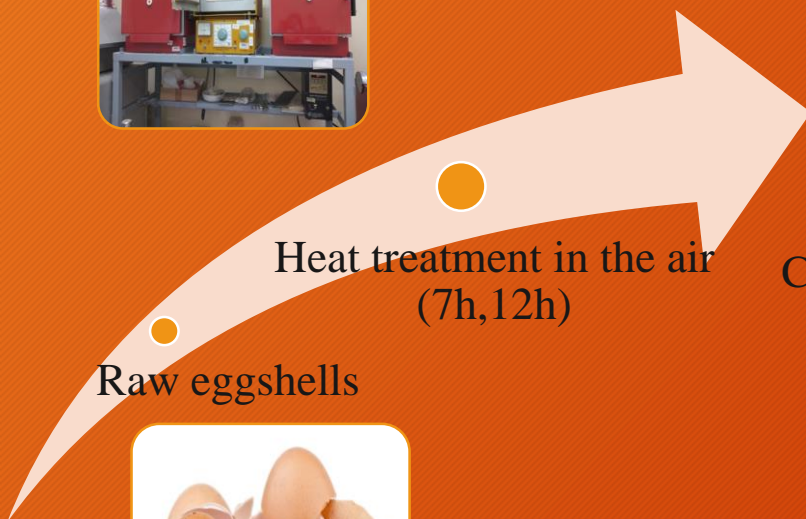
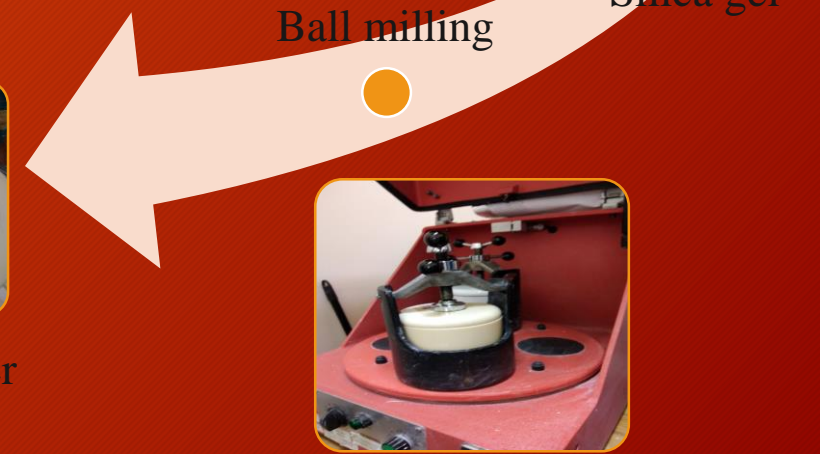
Ball milling



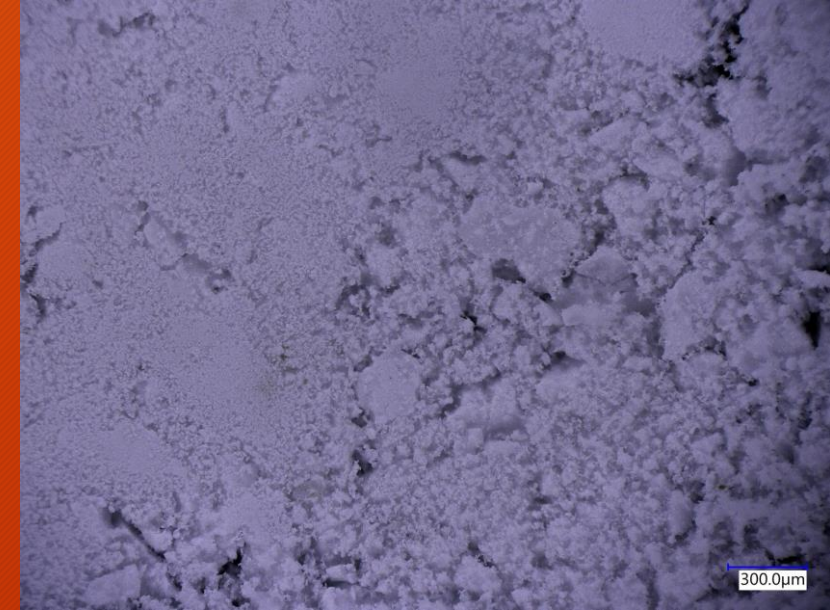
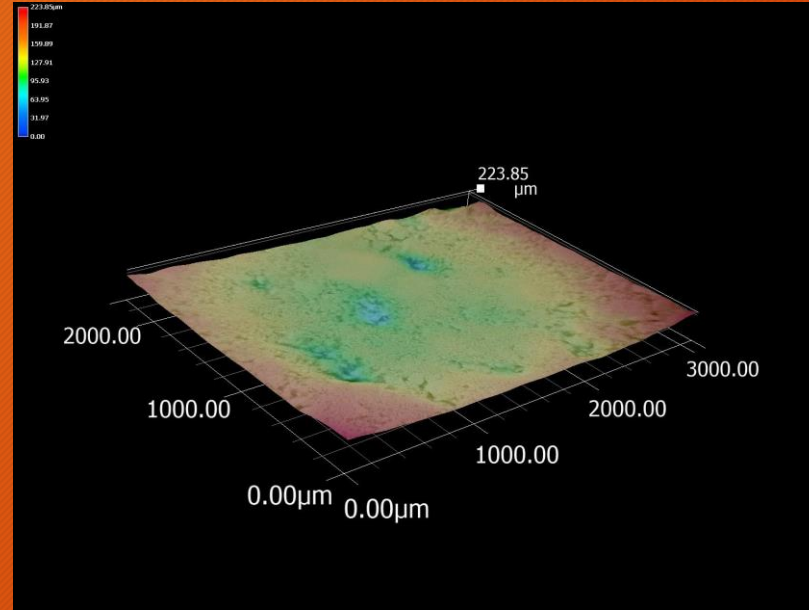
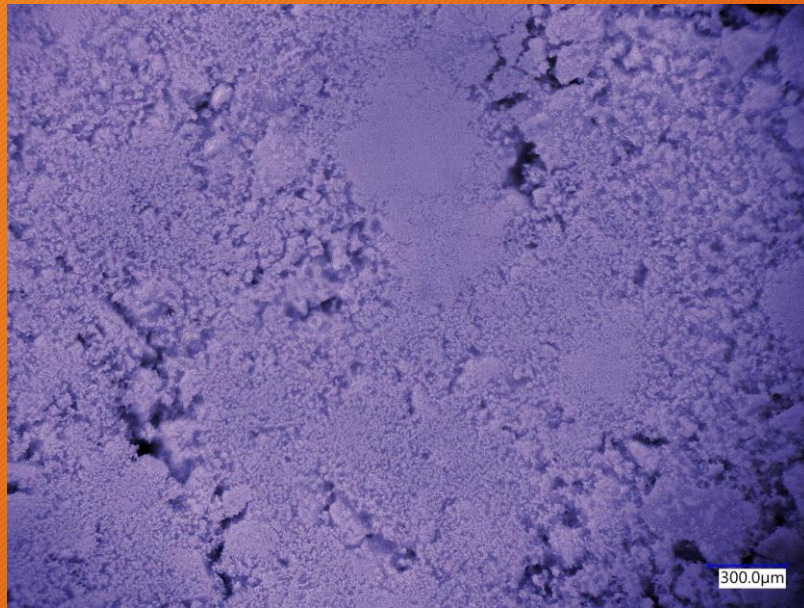
Silica powder

Calcium silicates

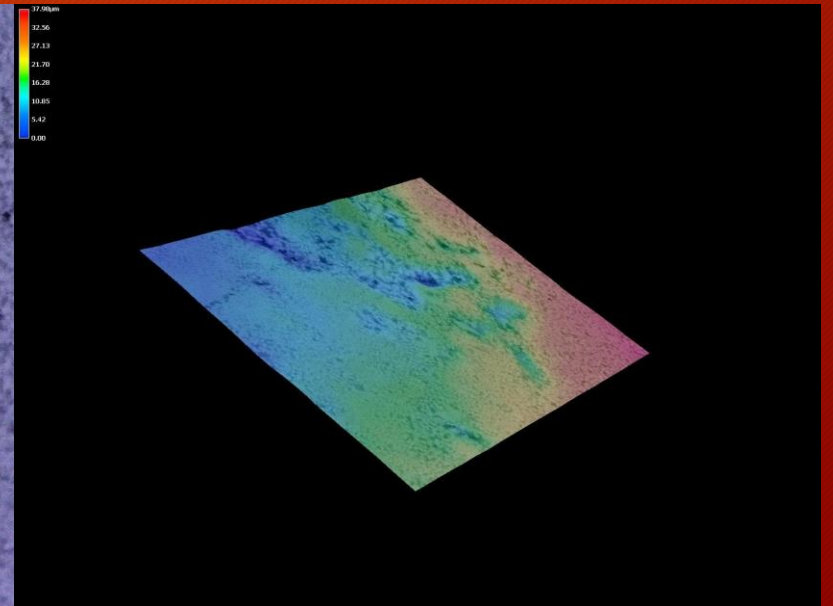
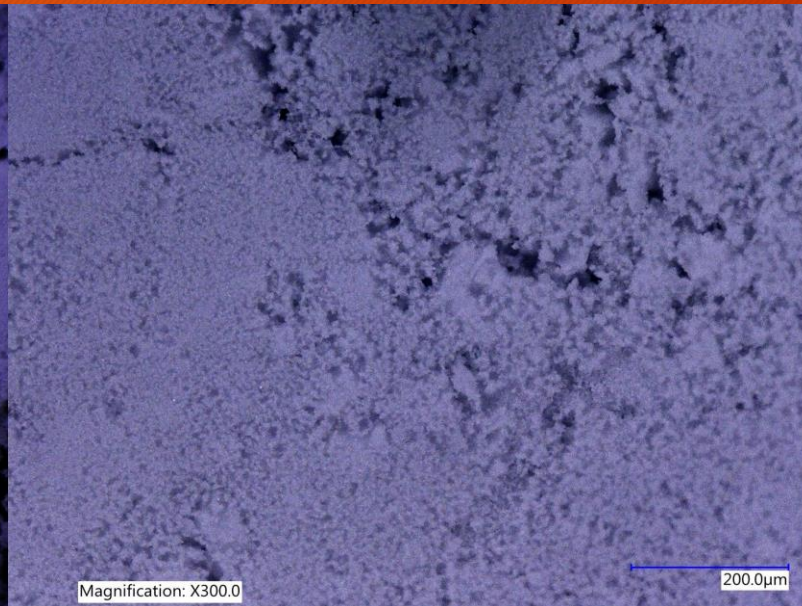
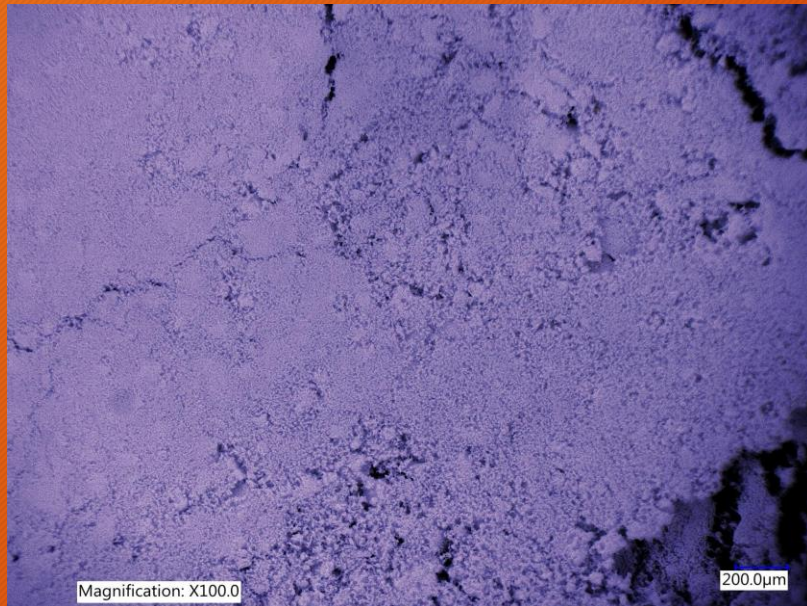
Raw eggshells



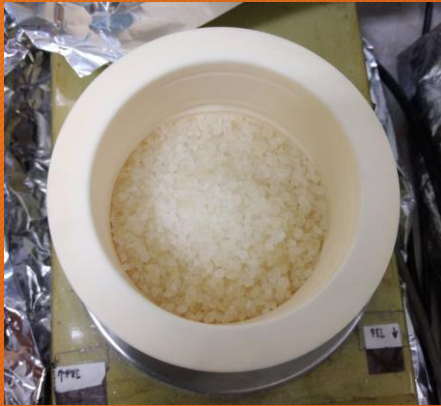
Samples analysis results using a digital microscopy for calcined eggshells at 900 °C for 12h



Samples analysis results using a digital microscopy for calcined eggshells at 900 °C for 7h



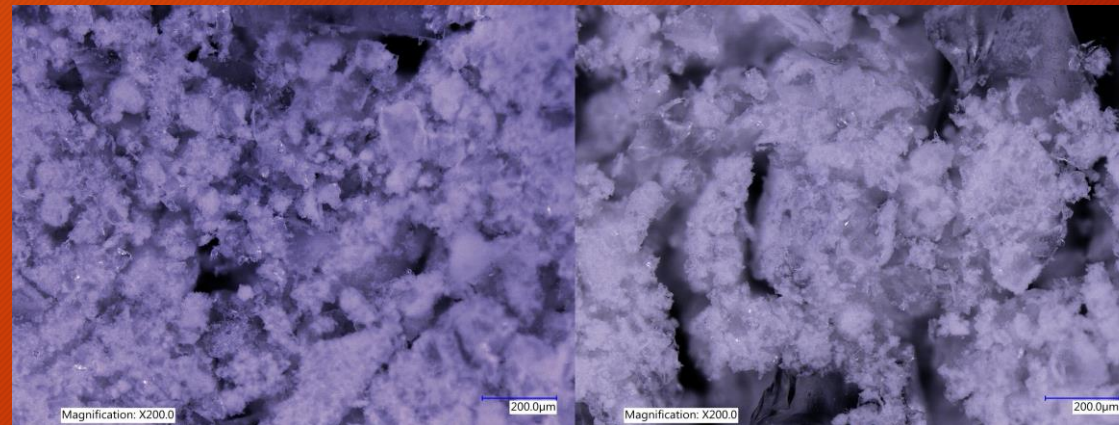
Starting materials



Silica gel (starting material)



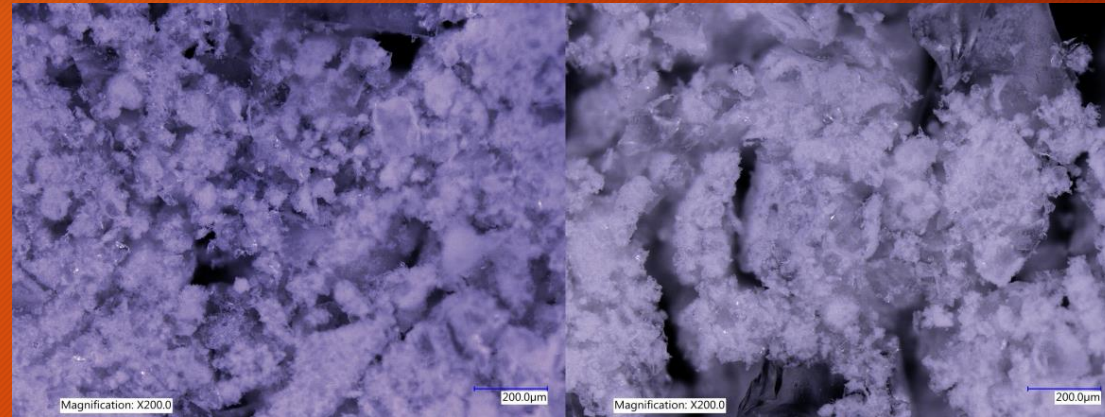
Milled Silica gel after 1 hour



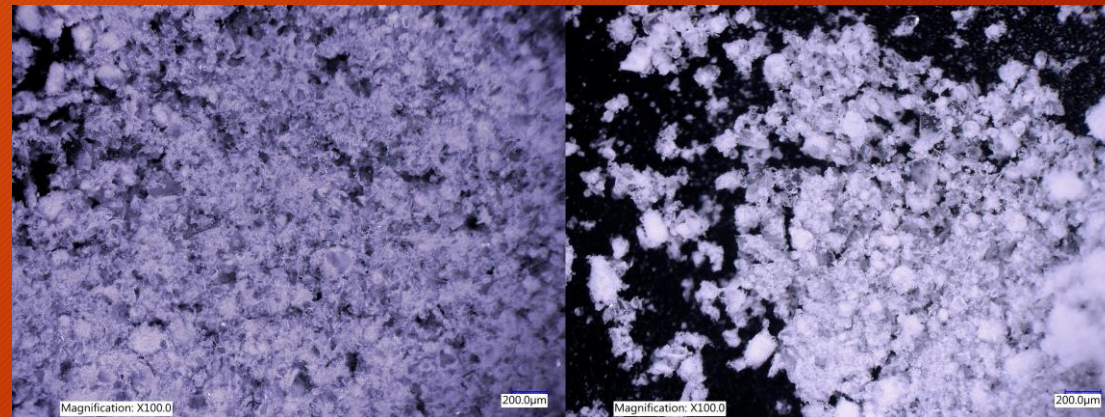
Starting materials



Milled Silica gel after 2 hours



Milled Silica gel after 3 hours (Silica powder)

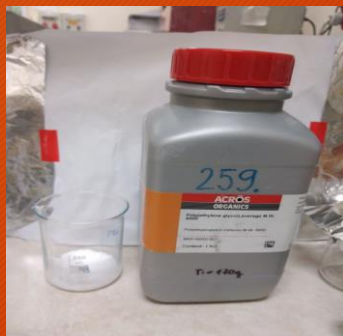


Powder mixtures preparation



Zirconia balls,
1mm in diameter

The powder mixture
(10C90S+Zirconia balls+Ethanol)



PEG (Poly Ethylene Glycol)



100 g of Ethanol



Attrition milling in wet conditions at
2000 rpm for 3h



Powder mixtures preparation



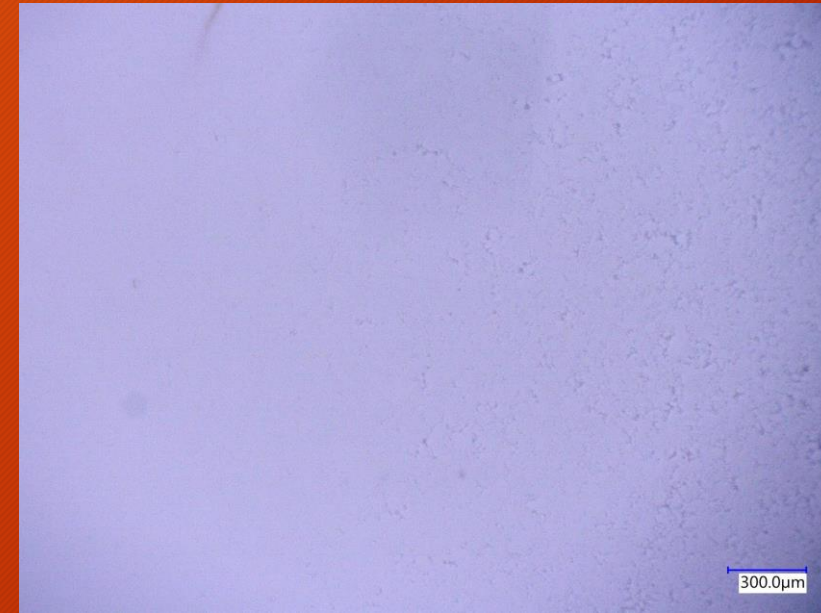
Drying the powder



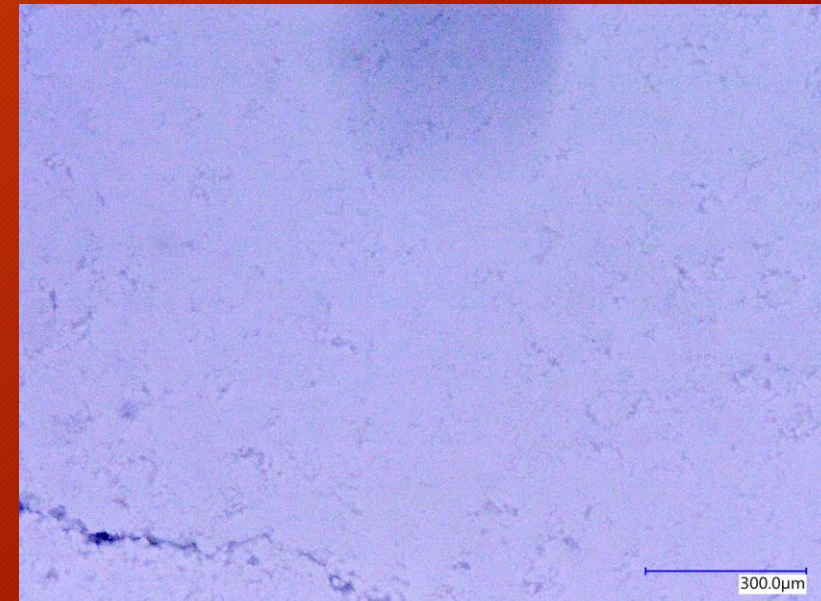
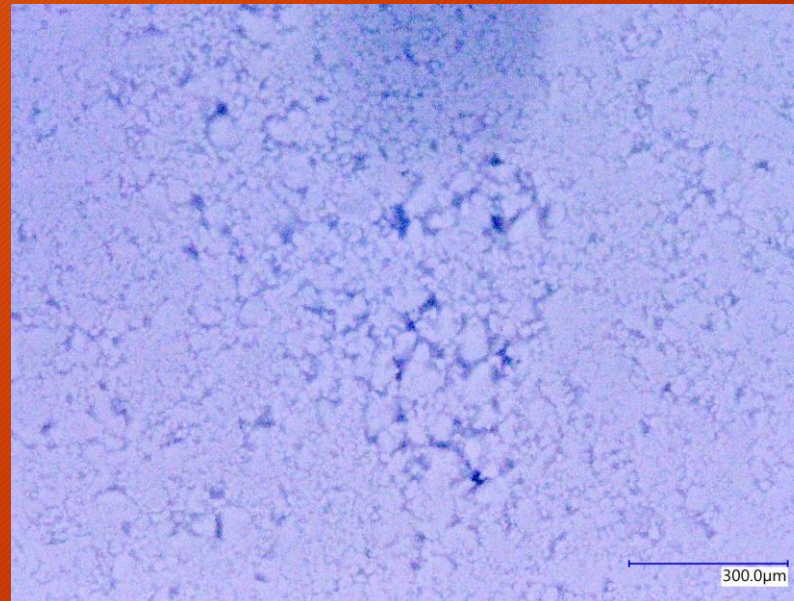
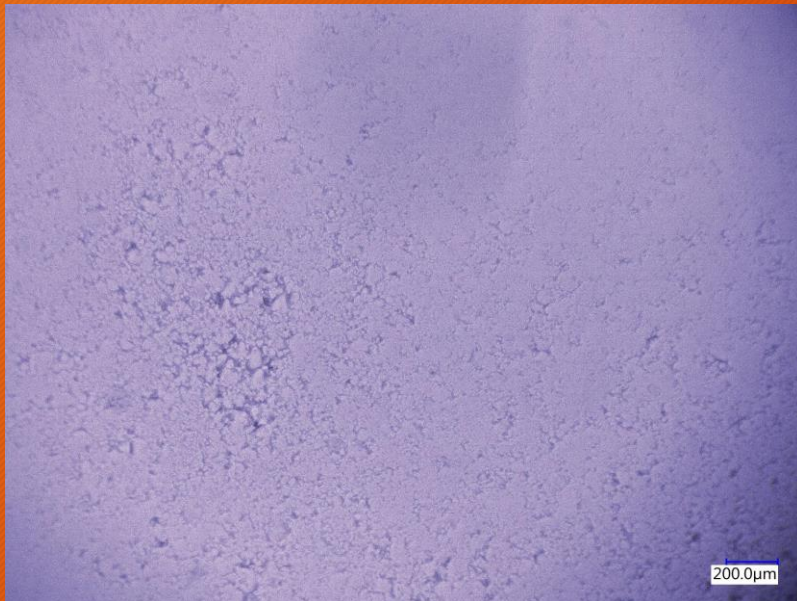
Sieving with a mesh size
100 μ m

Batch number	Powder composition
1585	10C90S
1586	20C80S
1587	30C70S
1588	40C60S
1589	50C50S
1590	60C40S
1591	70C30S
1592	80C20S
1593	90C10S
1584	40C60S

Samples analysis results using Keyence for 10C(12h)90S with PEG



Samples analysis results using Keyence for 40C(7h)60S with PEG



Research Plan



1. Semester (successful):

- 1) Powder technology (Dr. Balázs Csaba)**
- 2) Biomaterials for medical applications (Dr. Balázs Csaba)**

2. Semester (successful):

- 1) Transmission electronmicroscopy for structural investigations of different materials (Dr. Balázs Katalin)**
- 2) Selected chapters of material testing methods I.: FTIR, HPLC/MS (Dr. Erzsébet Takács), SEM, STM, AFM (Dr. Judit Telegdi)**
- 3) Hungarian I (Dr. Szloboda József Sándorné Katalin)**

Research Plan



3. Semester:

- 1) Composites (Dr. Klébert Szilvia), not yet passed the exam
- 2) Fracture mechanics (Dr. Kovács Tünde Anna), not yet passed the exam
- 3) Hungarian II (Dr. Szloboda József Sándorné Katalin), successful



Conferences:

- 1) Participated in [Virtual] European Congress and Exhibition On Advanced Materials and Progress - (EUROMAT 2021), September 12-16 (Poster).
- 2) Accepted abstract to participate in 46th international Conference and Exposition on Advanced Ceramics and Composites (ICCAC 2022), January 23-28 (Poster).
- 3) Submitted an abstract to participate in (ECerS 2022) conference, July 10-14 (Poster).



Research Plan



- I. Succeed in preparing the 10 batches with different composition.**
- II. All the samples have been investigated by XRD and some of them with SEM and EDS .**
- III. Preparing the first manuscript.**

Next steps:

- ✓ Continuing the preparation and sintering the samples in both forms bars and discs at 900°C and 1000°C.**
- ✓ Continuing with the mechanical testing (hardness, tribology, bending tests) and the morphological investigation.**
- ✓ Testing the biological characteristics for all the samples by emerging them in SBF solution.**



Thank you for your attention

***Köszönöm szépen a
figyelmet***

