

Óbuda University

Doctoral School of Materials Sciences and Technologies

HUN-REN, Centre for Energy Research,
Institute of Technical Physics and Materials Science



Development and structural characterization of bioceramics

PhD student :

Maroua Houria Kaou

Supervisors:

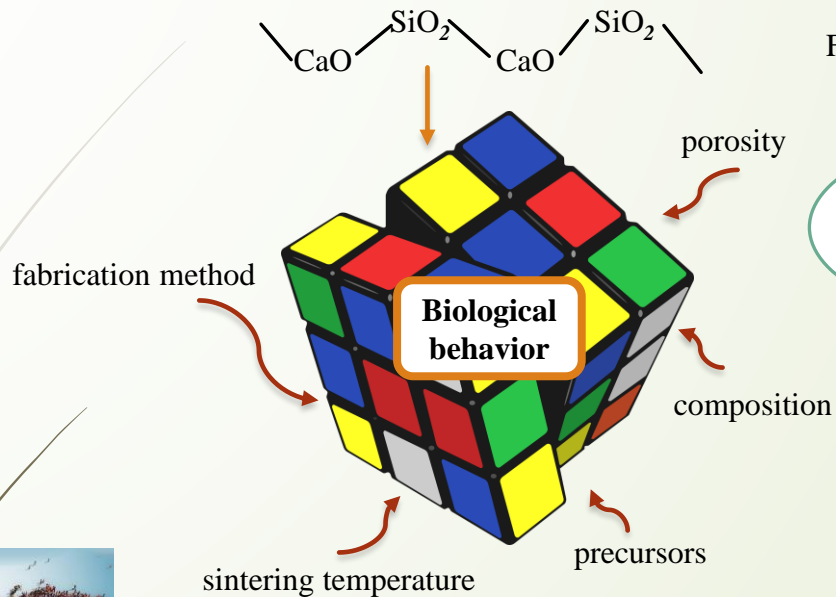
Dr. Csaba Balázs

Dr. Katalin Balázs

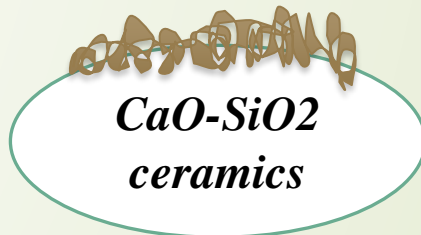


Recall from the previous semesters

Calcium Silicates ($CaO-SiO_2$)



Formation of an apatite layer



Non-biomedical applications

CaO-SiO₂ system

- Low thermal conductivity, high strength, lightweight, fireproof, high physical water absorption
- Excellent bioactivity, biocompatibility, and degradation rate

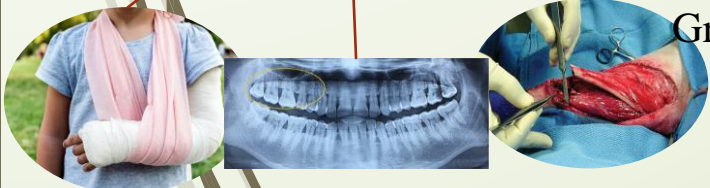
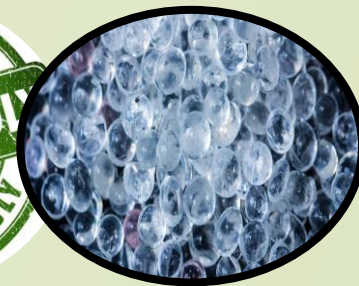
Biomedical applications



New approach has been trending !!!

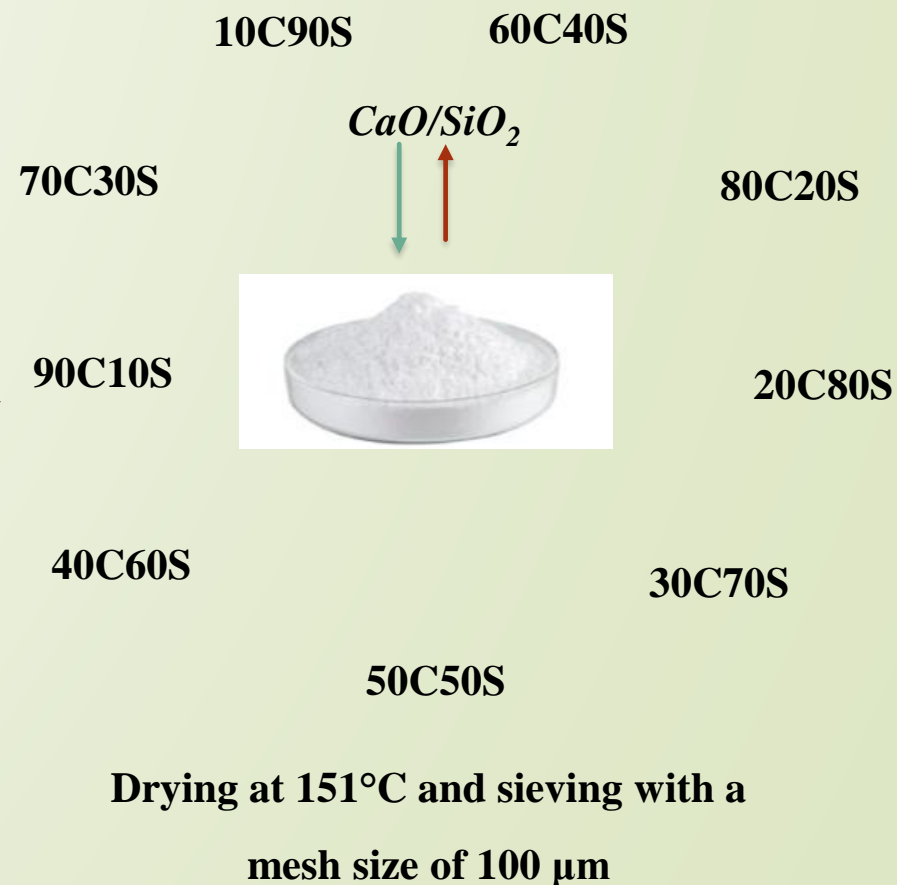
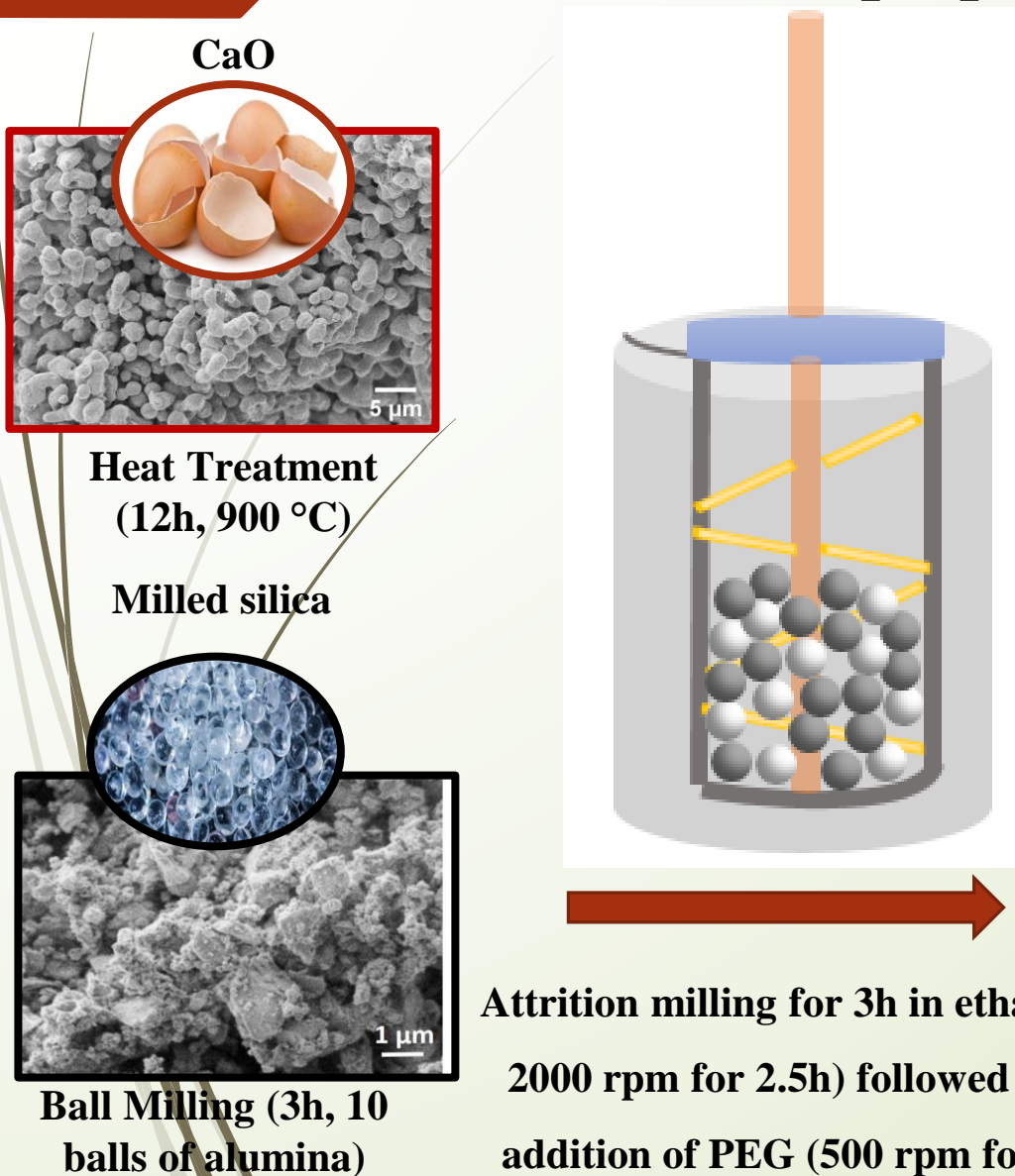


Green environment synthetic routes



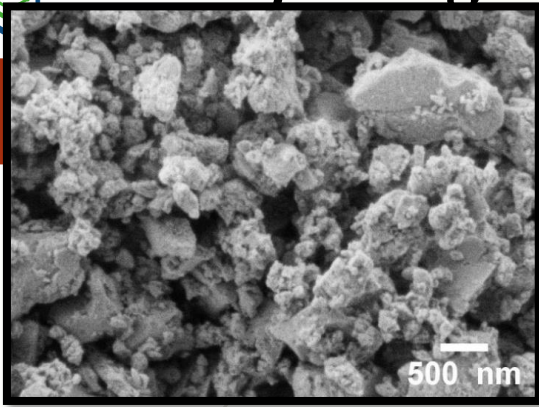


Flashback on the preparation process

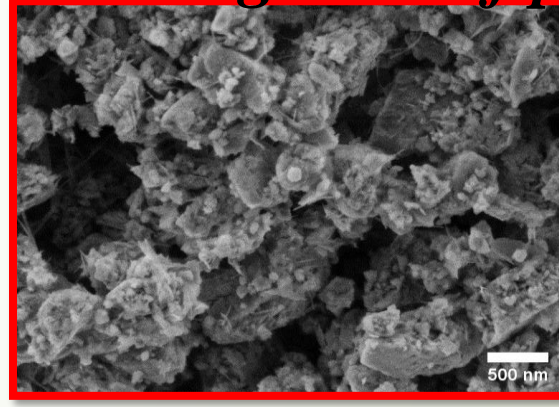




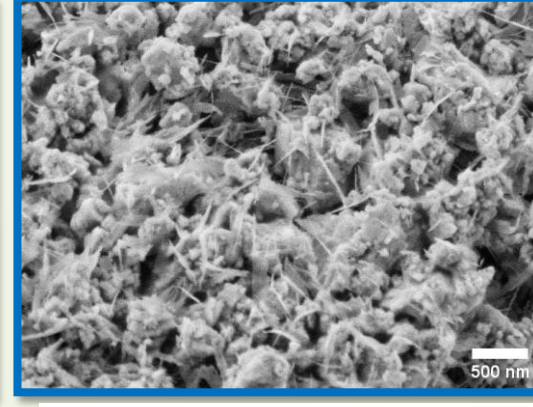
Morphological investigation of powders



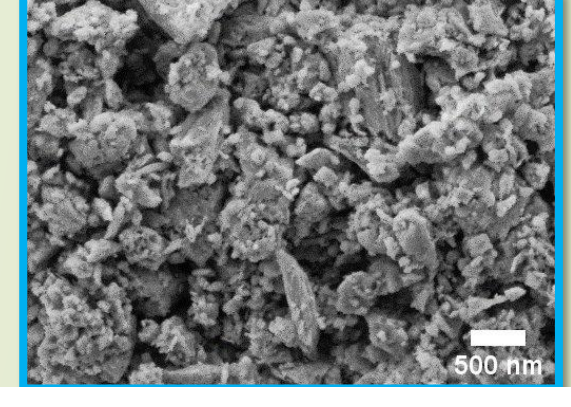
10 wt% CaO / 90 wt% SiO₂



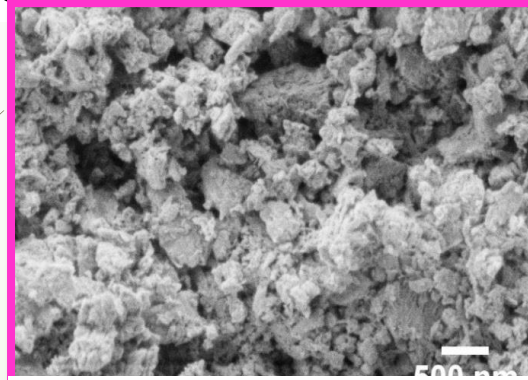
20 wt% CaO / 80 wt% SiO₂



30 wt% CaO / 70 wt% SiO₂

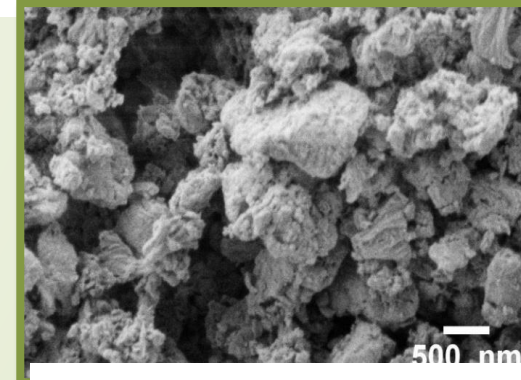


40 wt% CaO (7h) / 60 wt% SiO₂

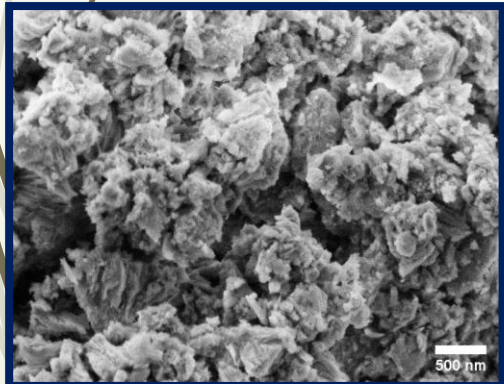


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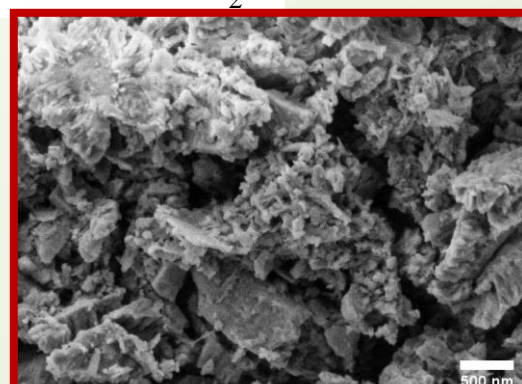
Calcium silicate powders



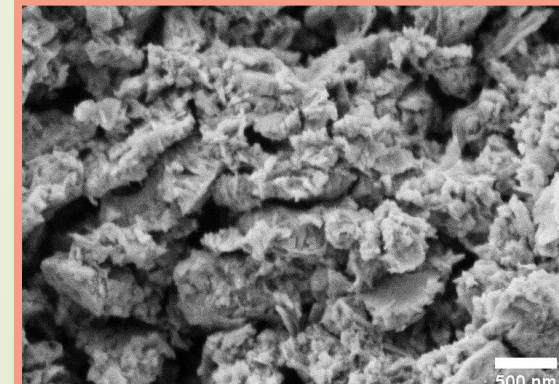
50 wt% CaO / 50 wt% SiO₂



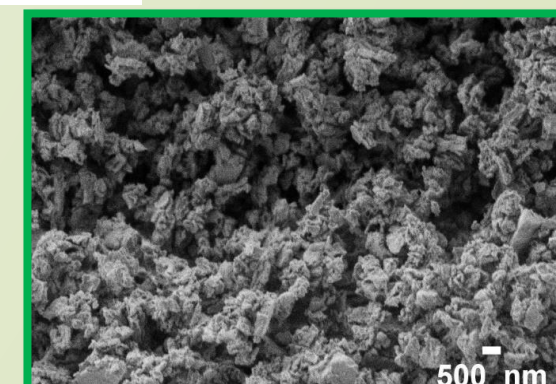
60 wt% CaO / 40 wt% SiO₂



70 wt% CaO / 30 wt% SiO₂



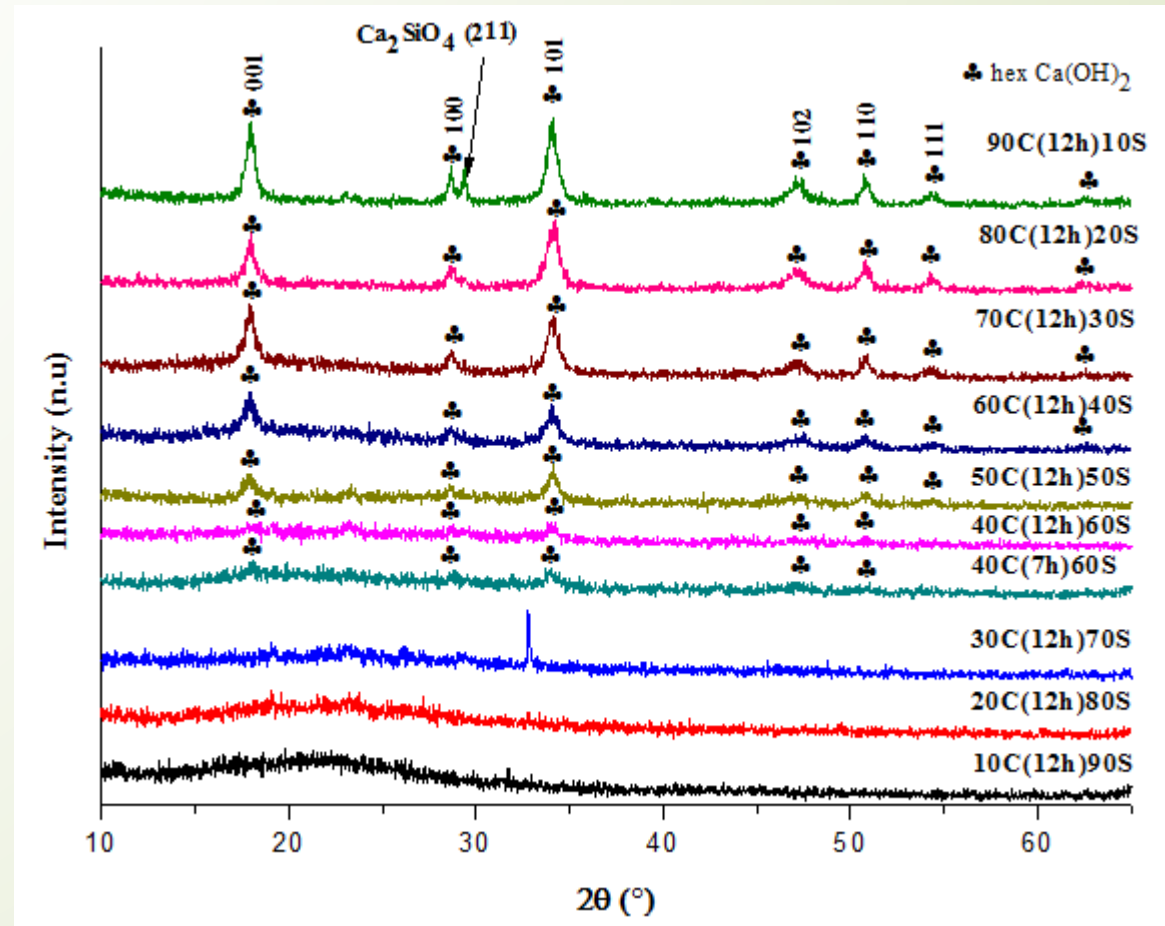
80 wt% CaO / 30 wt% SiO₂



90 wt% CaO / 10 wt% SiO₂



Structural investigation of powders



XRD patterns of calcium silica powders



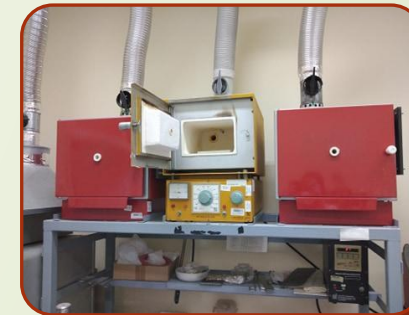
3. Preparation of ceramic discs

Pressing (Dry, 180 bar,

Calcium silicate powders



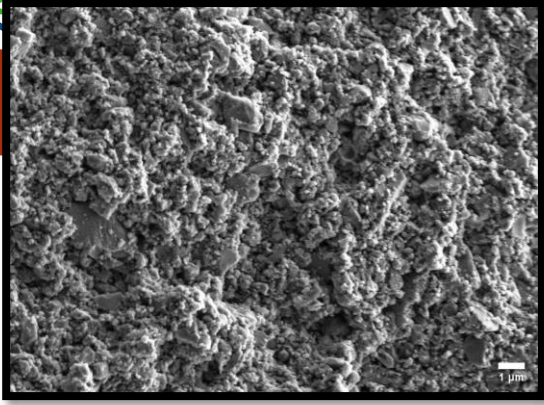
Heat treatment (Air, 900°C, 1h)



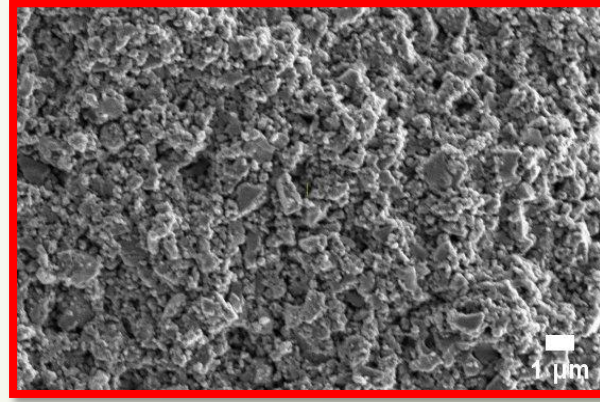
Composition name					
Real image of the heat-treated bioceramic	10C90S	20C80S	30C70S	40C60S	50C50S
	60C40S	70C30S	80C20S	90C10S	40C(7h)60S



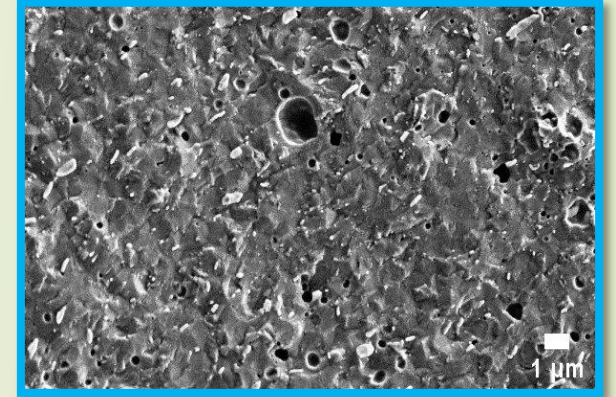
Morphological investigation of ceramics



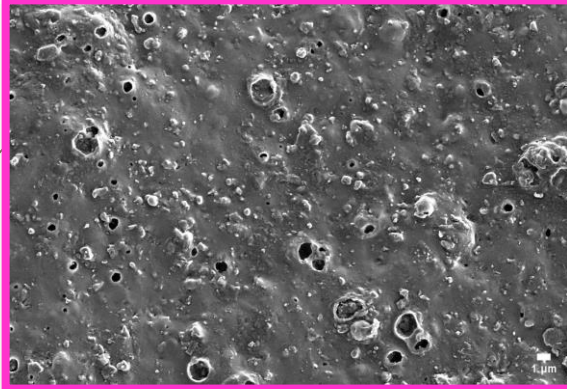
10 wt% CaO / 90 wt% SiO₂



20 wt% CaO / 80 wt% SiO₂

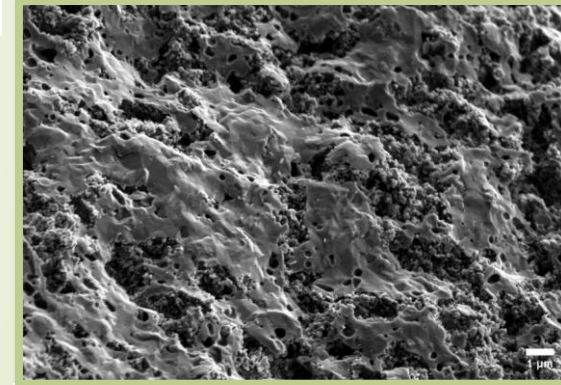


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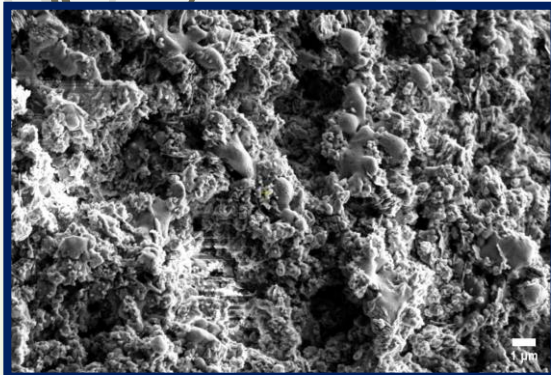


40 wt% CaO / 60 wt% SiO₂

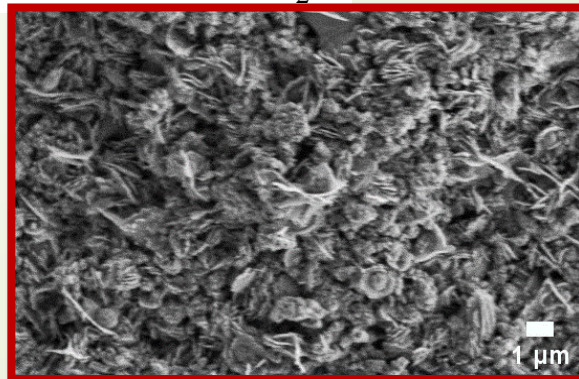
Calcium silicate powders



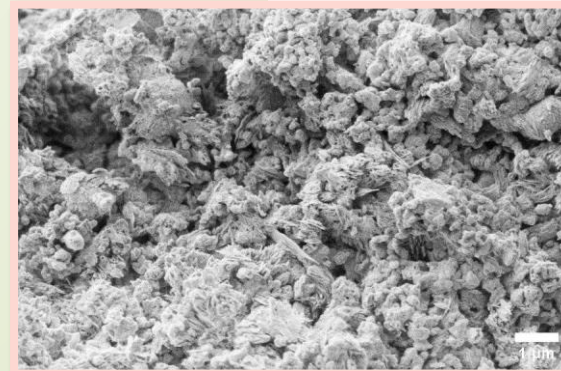
50 wt% CaO / 50 wt% SiO₂



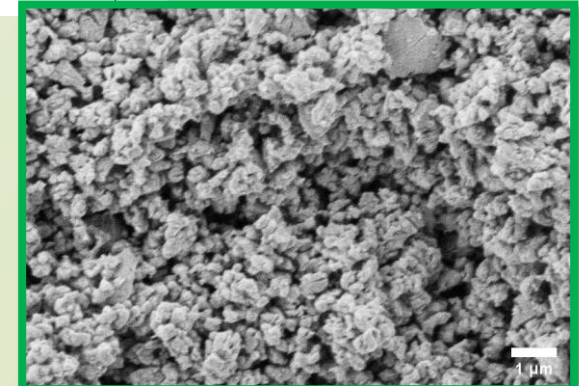
60 wt% CaO / 40 wt% SiO₂



70 wt% CaO / 30 wt% SiO₂



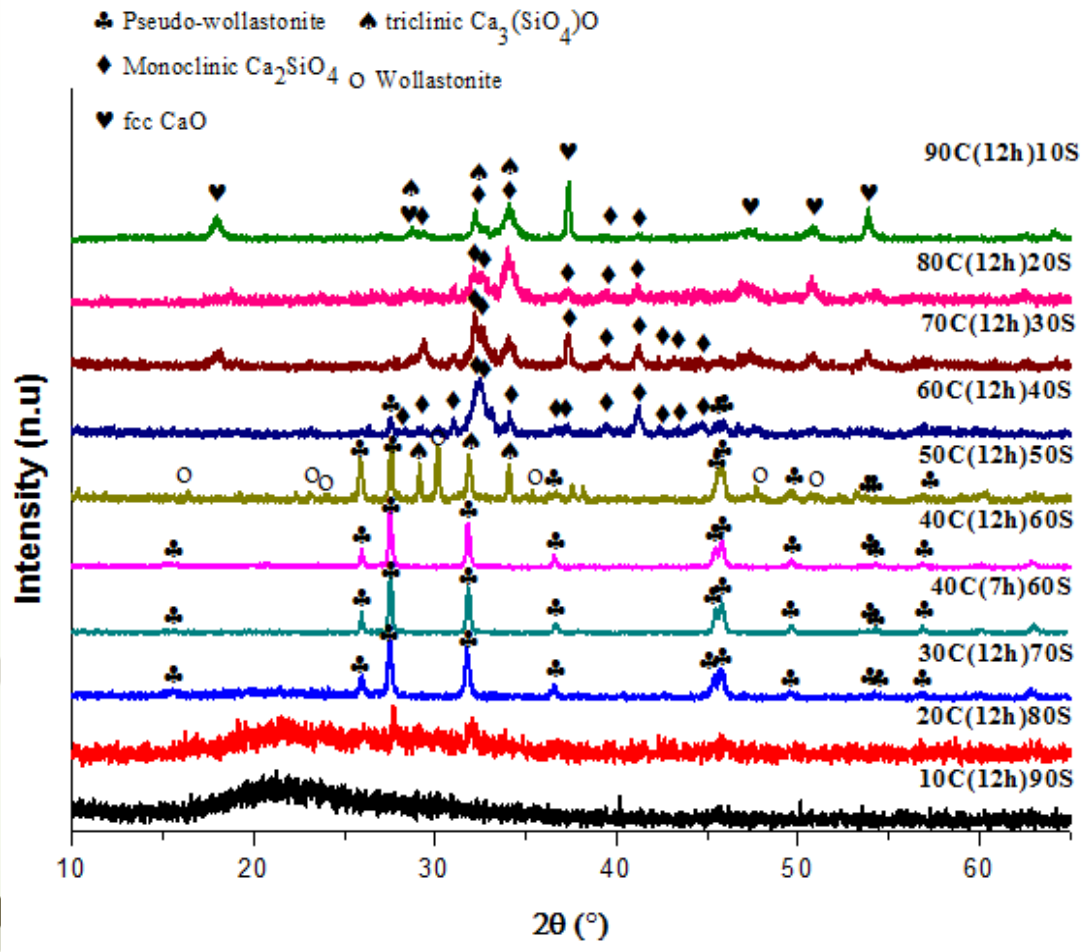
80 wt% CaO / 30 wt% SiO₂



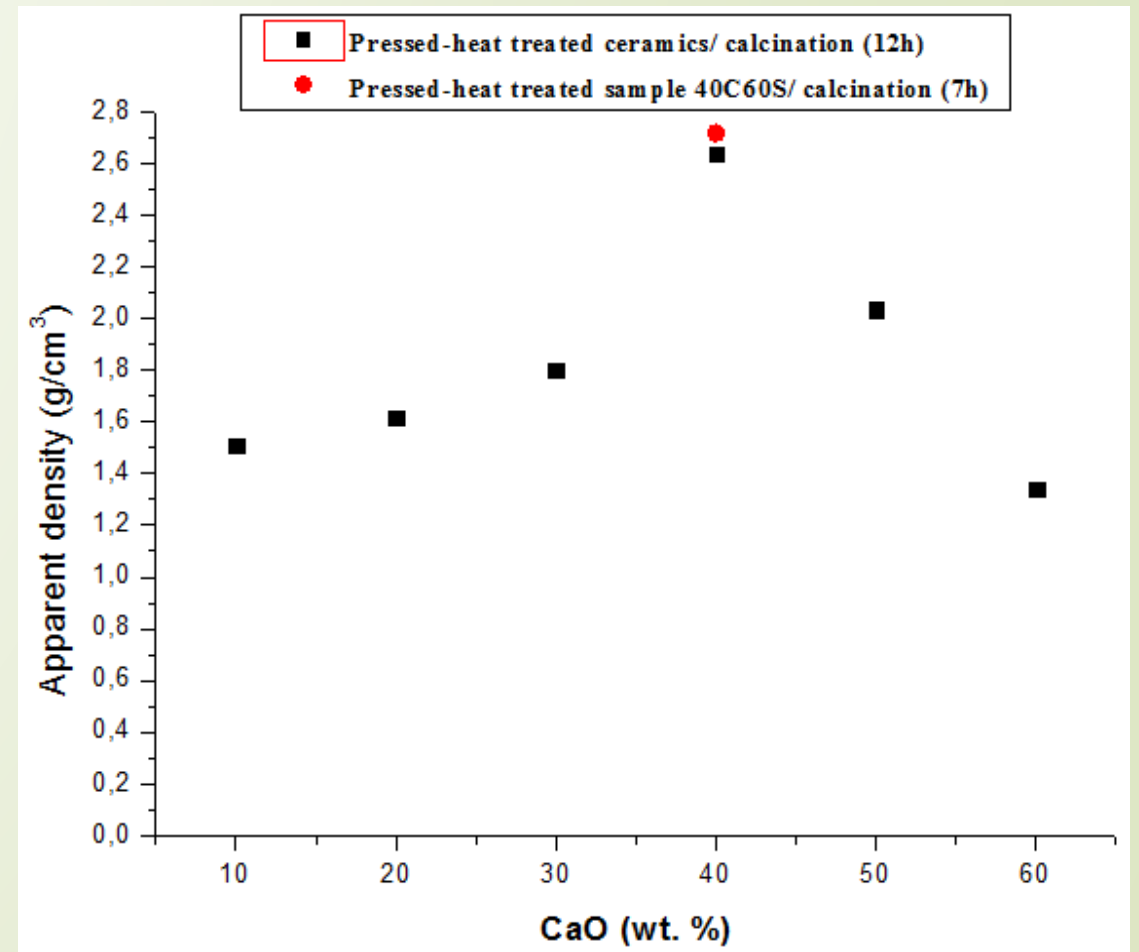
90 wt% CaO / 10 wt% SiO₂



Effect of composition on the final ceramics



XRD patterns of calcium silica ceramics



Density diagram



Results

1. Semester:

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

3. Semester:

- 1) Fracture mechanics (Dr. Kovács T. A)**
- 2) Composites (Dr. Klébert Sz.),**
- 3) Hungarian II (Dr. Szloboda József Sándorné K.)**

2. Semester:

- 1) Transmission electron microscopy for structural investigations of different materials (Dr. Balázs K.)**
- 2) Selected chapters of material testing methods I. (Dr. Takács E, Dr. Judit Telegdi)**
- 3) Hungarian I (Dr. Szloboda József Sándorné K.)**

4. Semester:

- 1) Cellulose chemistry (Dr. Borsa Judit)**
- 2) Synthetic fibres and textiles (Dr. Borsa Judit)**



Presentations and publications

Publications

[1] Kaou, Maroua H.; Horváth, Zsolt E.; Balázs, Katalin; Balázs, Csaba. Eco-friendly preparation and structural characterization of calcium silicates derived from eggshell and silica gel. **INTERNATIONAL JOURNAL OF APPLIED CERAMIC TECHNOLOGY** 20: 2 pp. 689-699, 11 p. (2023).

[2] Kaou, Maroua H.; Furkó, Mónika ; Balázs, Katalin ; Balázs, Csaba. Advanced Bioactive Glasses: The Newest Achievements and Breakthroughs in the Area. **NANOMATERIALS** 13: 16 Paper: 2287, 33 p. (2023)

[3] Kaou, Maroua H.; Furkó, Mónika ; Balázs, Katalin ; Balázs, Csaba. Morphological and structural evaluation of spark plasma sintered calcium silicate ceramics. **INTERNATIONAL JOURNAL OF APPLIED CERAMIC TECHNOLOGY** [In print].

Conferences:

1) Participated in [Virtual] European Congress and Exhibition On Advanced Materials and Progress - (EUROMAT 2021), September 12-16 (Poster).

2) Participated in [Virtual] 46th international Conference and Exposition on Advanced Ceramics and Composites (ICACC 2022), January 23-28 (Poster).





Presentations and publications

3) Participated in Ceramics In Europe (ECerS 2022) conference, July 10-14 (Poster).



4) Participated in [Virtual] ACerS Pan American Ceramics Congress (PACC-FMAs 2022), July 24-28 (Poster).

5) Participated in International Hybrid Conference on Nano Structured Materials and Polymers (ICNP), May 12-14 (Invited talk, virtual).



Research Plan

Next steps:

- ✓ **Preparing 2 manuscripts.**
- ✓ **Completing the biological testing and characterization of the samples.**
- ✓ **Writing my thesis**

Thank you for your attention!

