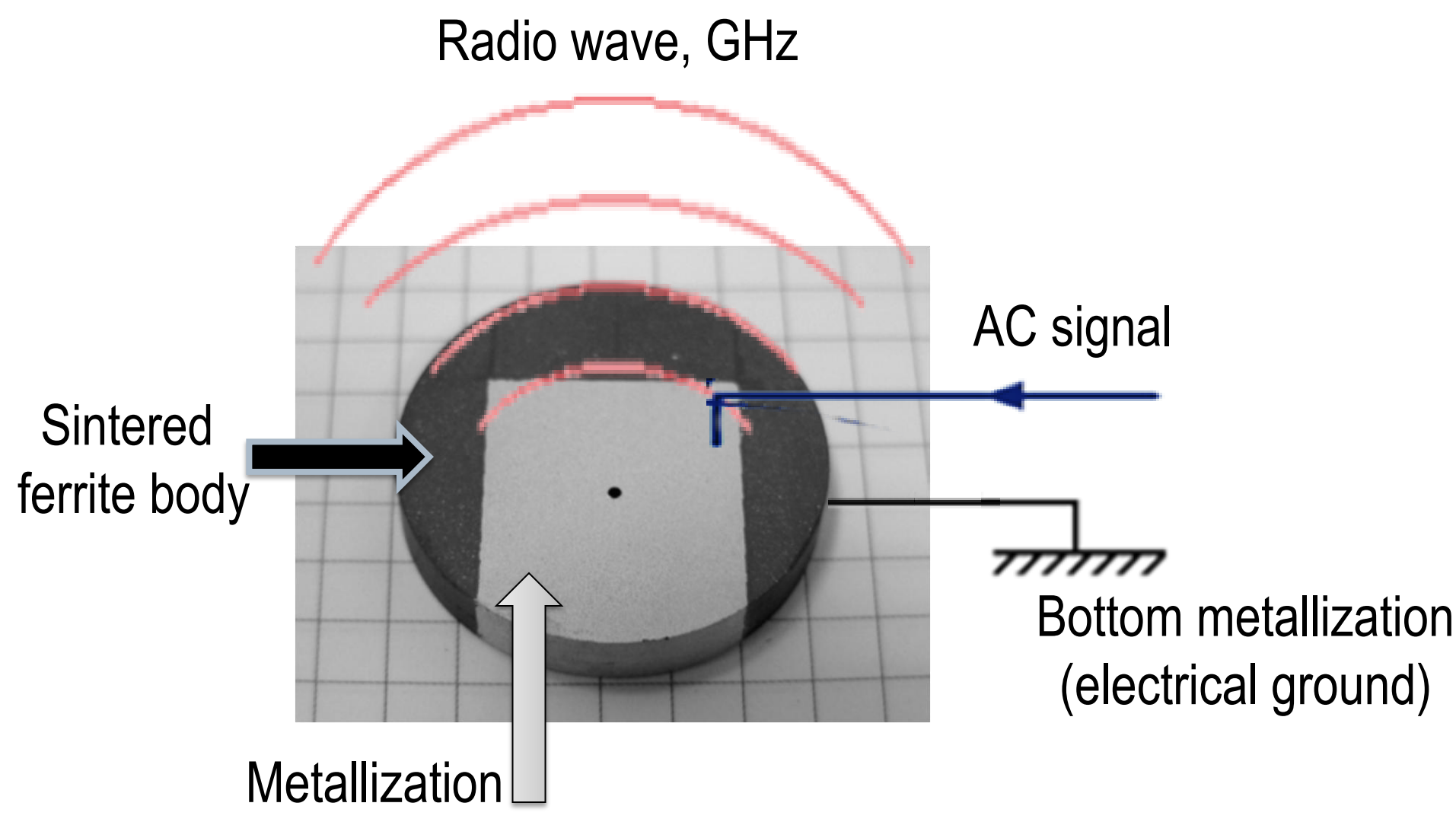


Abstract

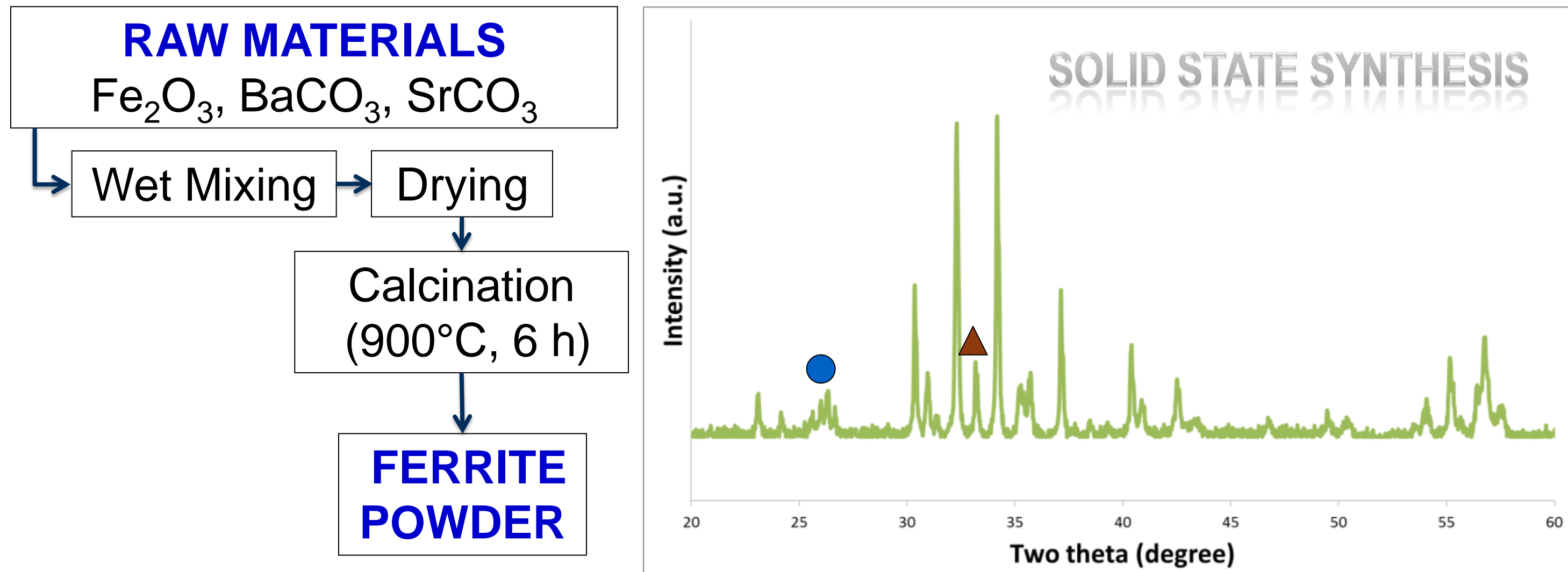
Hexaferrites of M-type at high-frequency are investigated, owing to their higher ferro-magnetic resonances as compared to traditional magnetic materials, thus ensuring a less dispersive behavior of the material at microwaves frequencies. Here we present the experimental work concerned with the ceramic process for the production of the barium-strontium hexaferrite (BSFO). The critical issue in the production of this material is to obtain a fully dense and homogeneous microstructure. These aspects have been addressed by introducing powder grinding processes, and by varying the cold consolidation conditions of the powders. A number of samples of the material have been produced, both for morphological and microstructural characterization and a demonstrator antenna, onto which conductive patches were applied, and the radiating properties of which were tested. Barium-strontium hexaferrite as supporting material for antennas - while allowing substantial device miniaturization - displays relatively high dielectric and magnetic losses.



Printed antenna with diameter 31.5 mm

Material synthesis

Barium-Strontium M-type hexaferrites: Ba_{0.75}Sr_{0.25}Fe₁₂O₁₉ (BSFO)

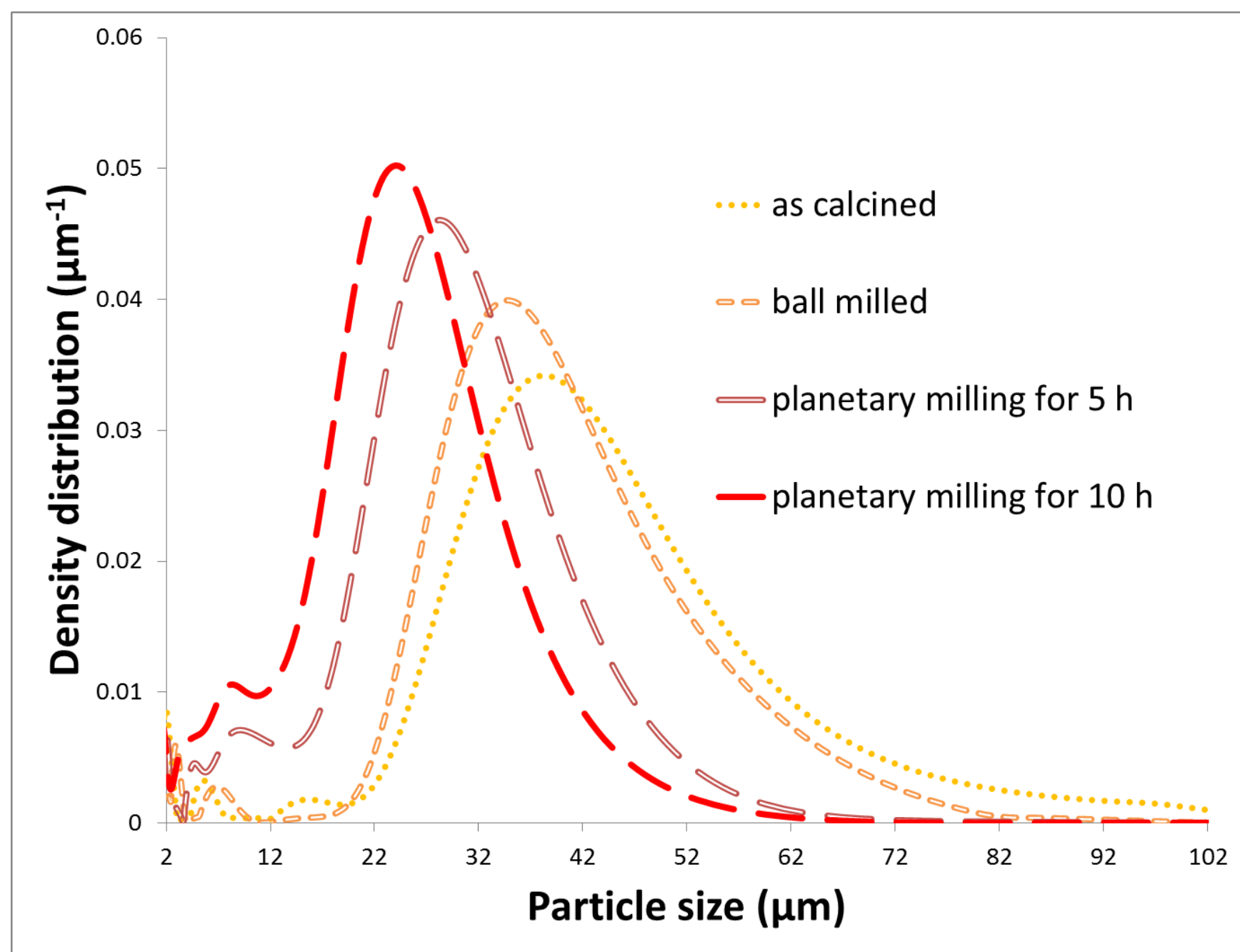


The powders after calcination doesn't shown a pure M-type hexaferrite phase, but some intermediate phase, such as BaO (●) and Fe₂O₃ (▲), are still presented

Key step: Powders Milling

The wet Planetary Milling (PM) has the double scope of:

- increase the powders homogeneity in terms of particle size and shape
- increase the powders reactivity reducing the average particle size



Powders	as calcined	ball milled	PM 5 h	PM 10 h
Mean particle size (μm) weighted on number	45	40	30	26
Mean particle size (μm) weighted on volume	51	44	33	28

Densification

Forming :

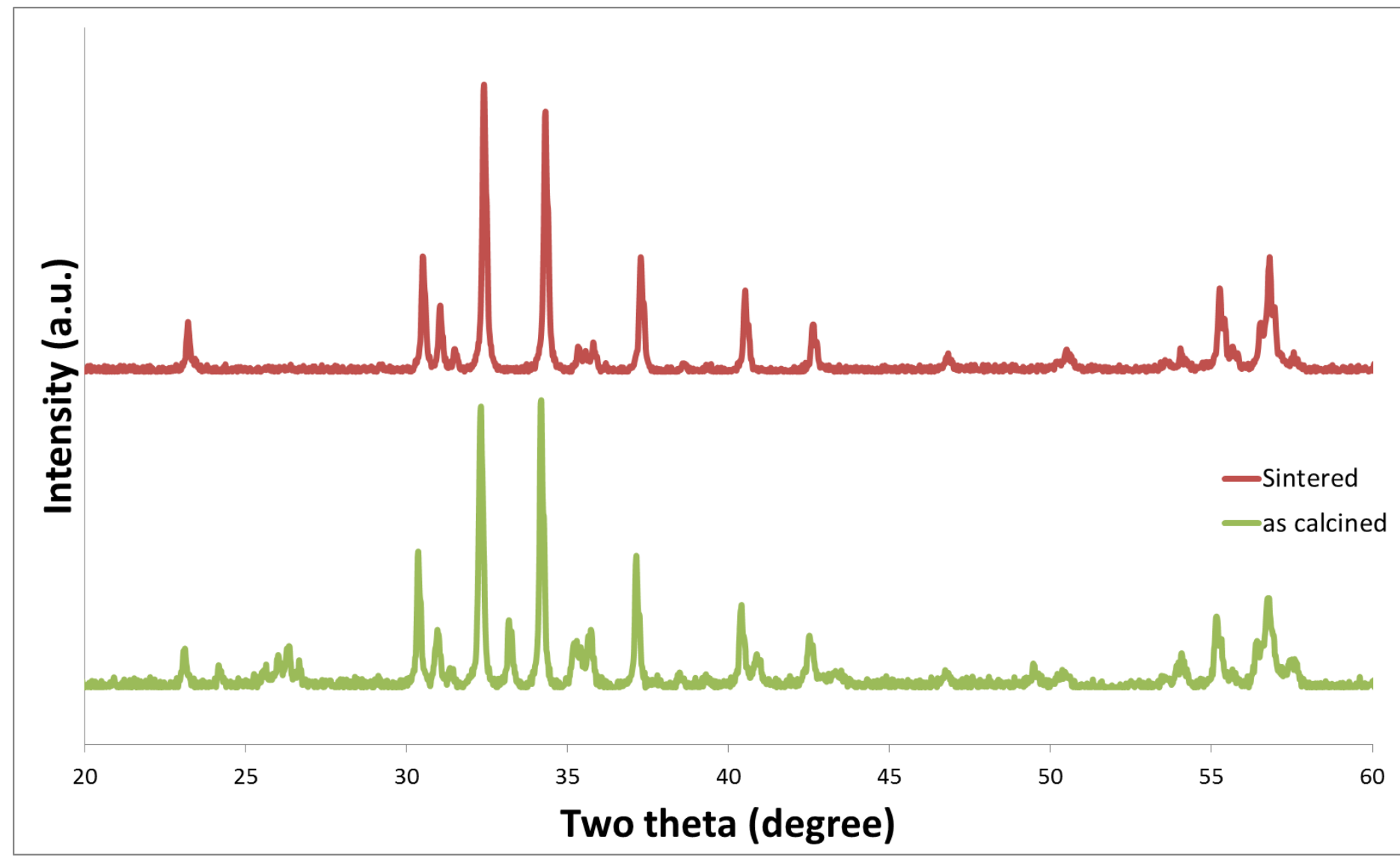
- linear pressing into disk
- cold isostatic pressing at 300 MPa

$$\rightarrow \rho_{\%} \approx 56 \%$$

Sintering :

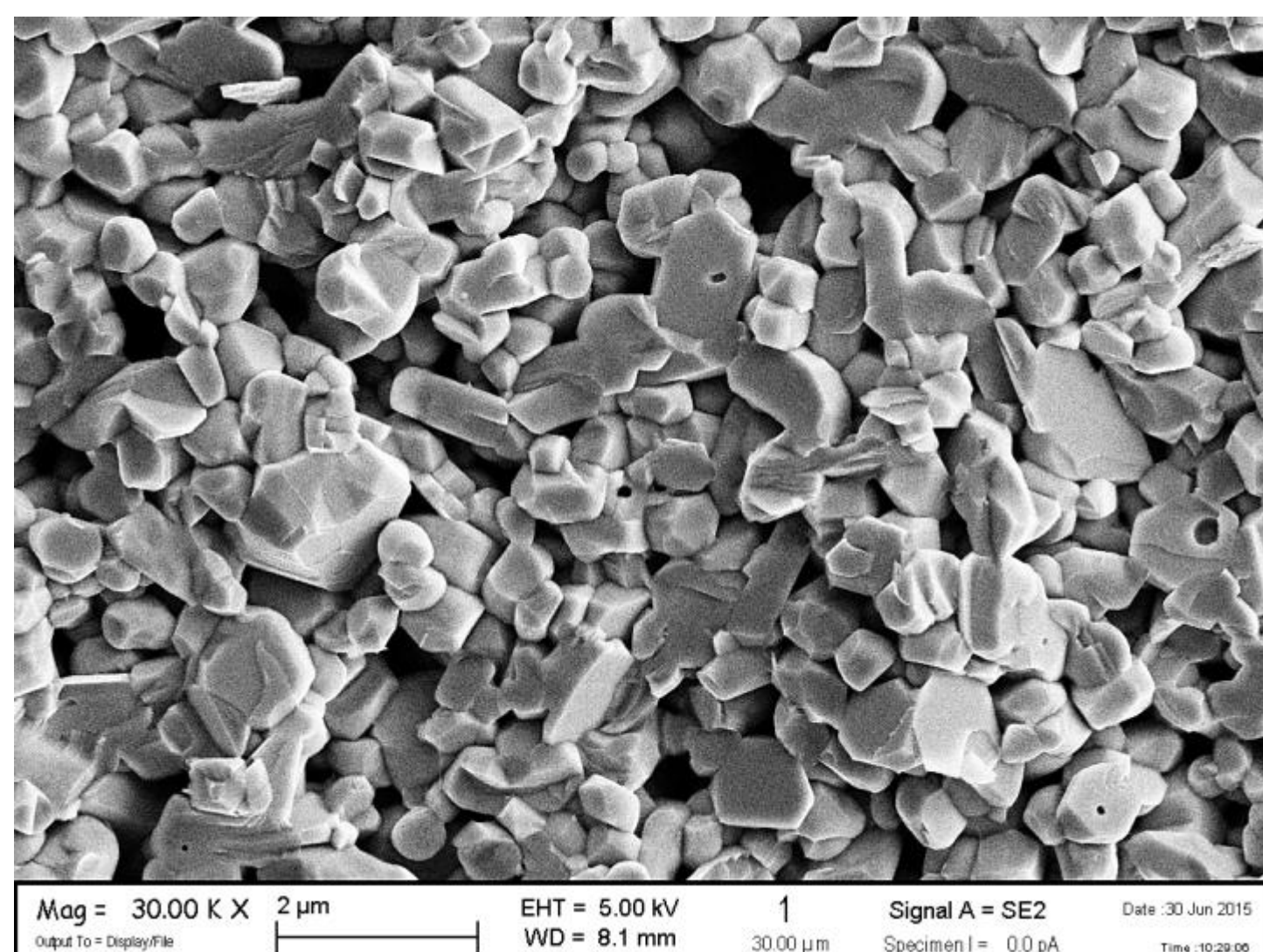
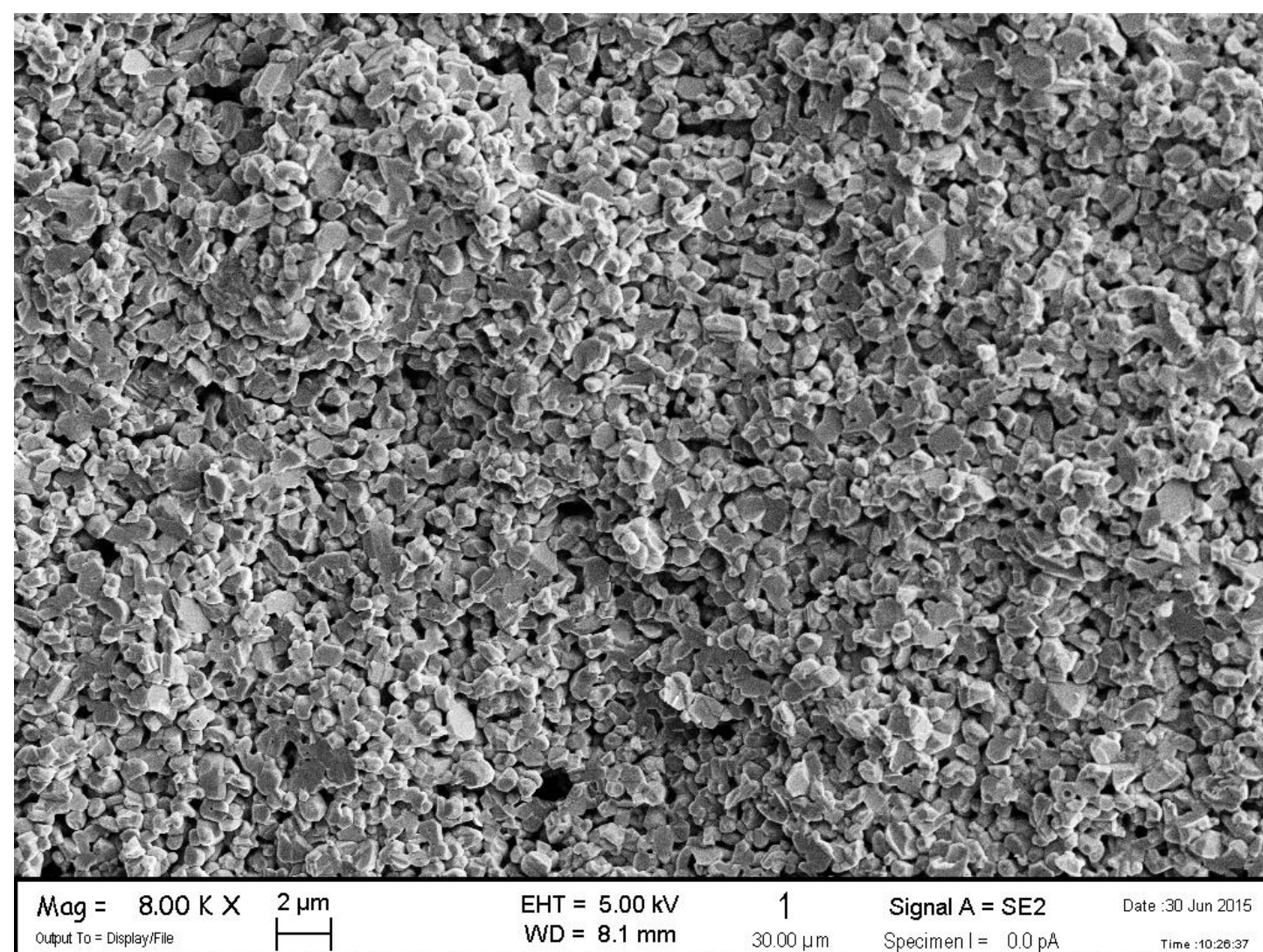
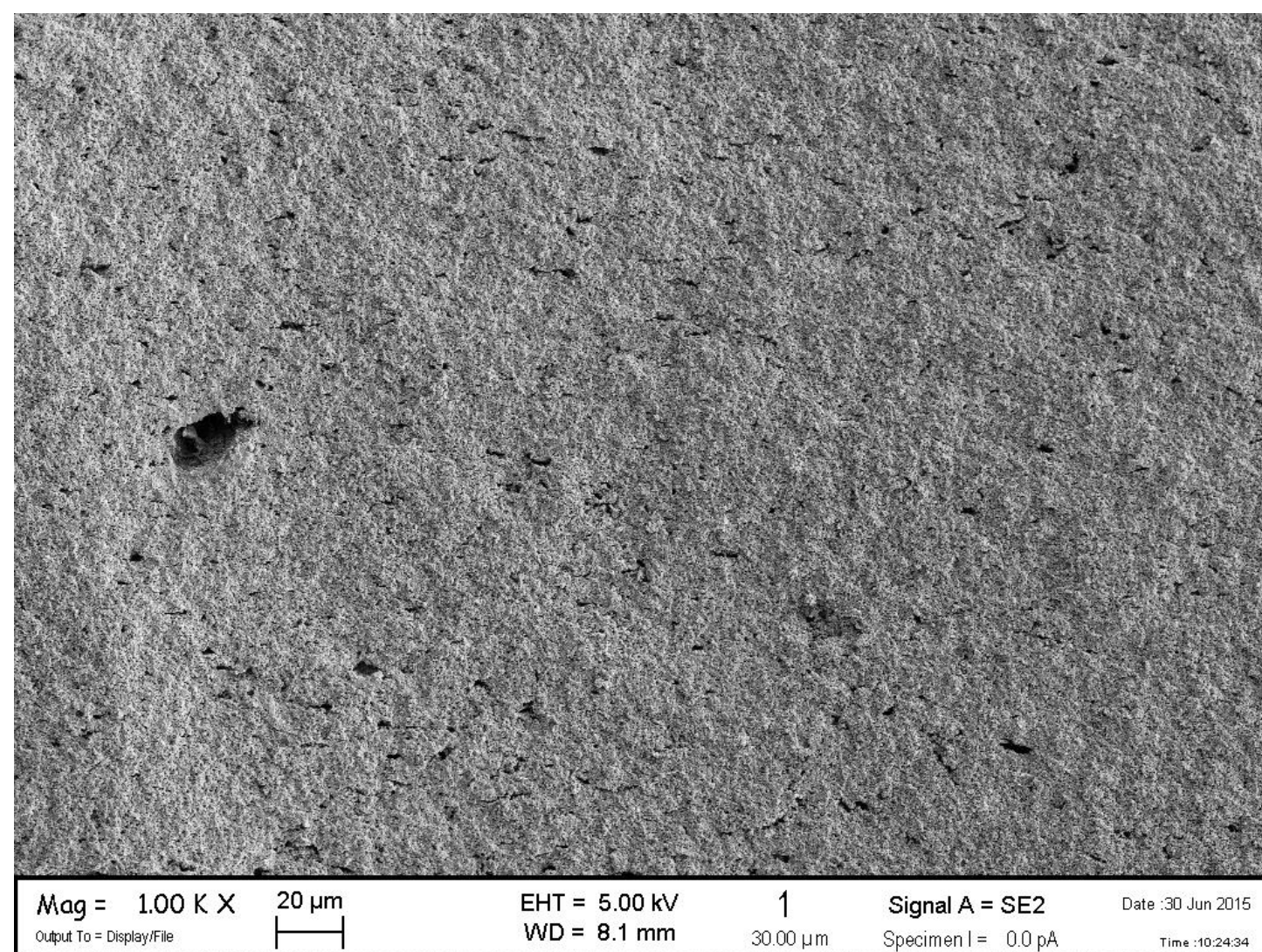
- Heating at 10 °C/min up to 1200 °C
- 1' soaking time

$$\rightarrow \rho_{\%} > 90 \%$$



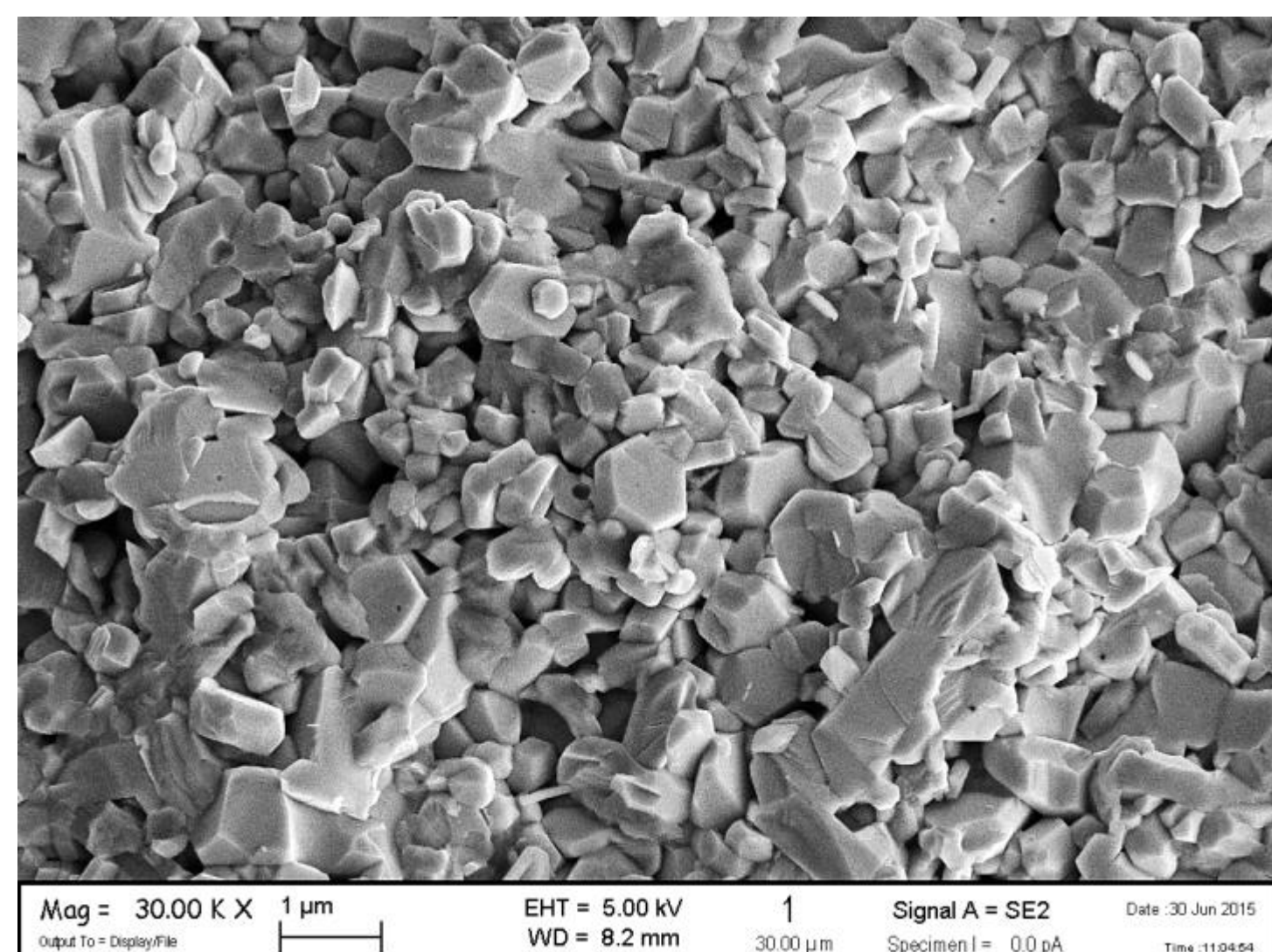
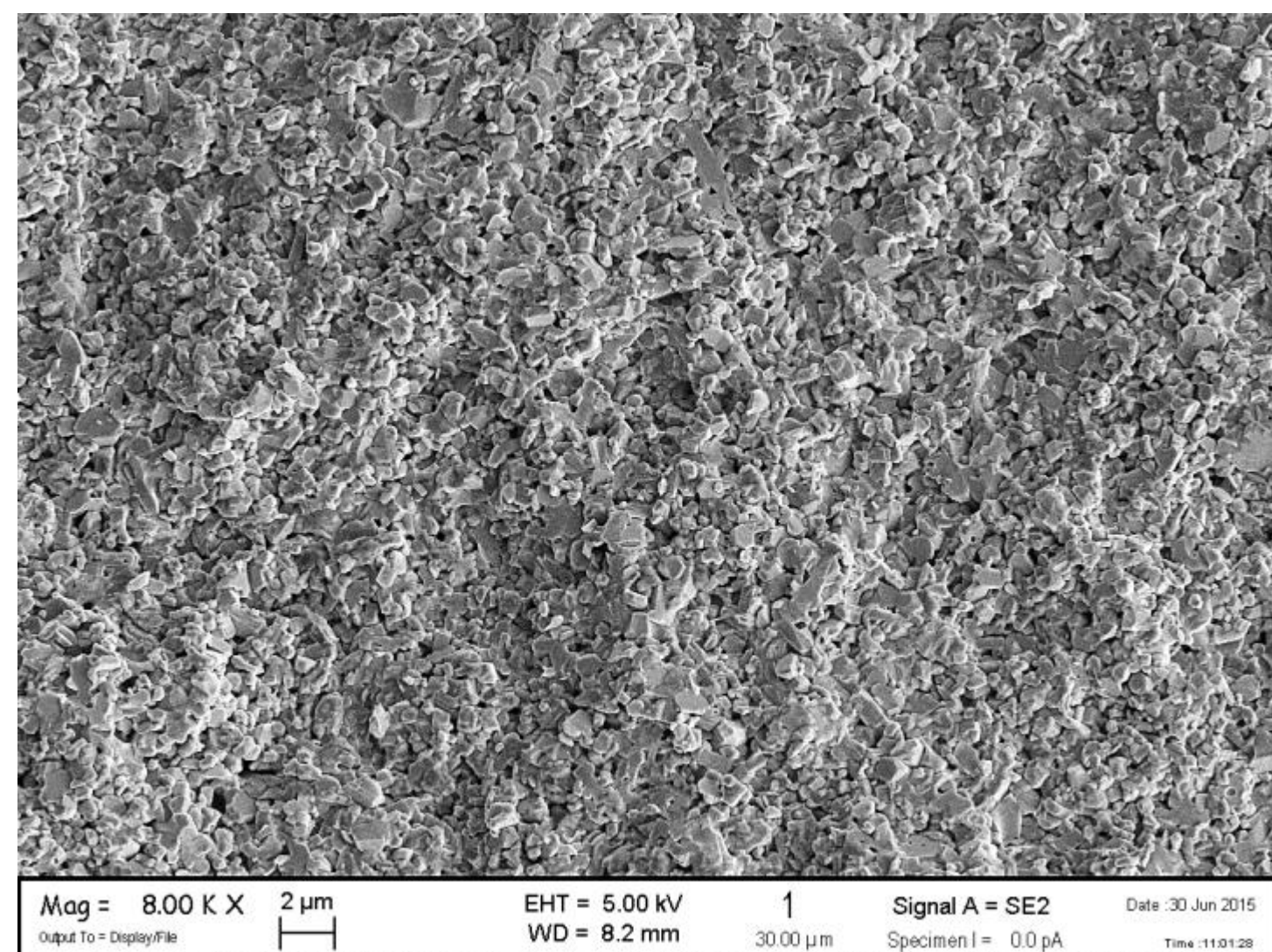
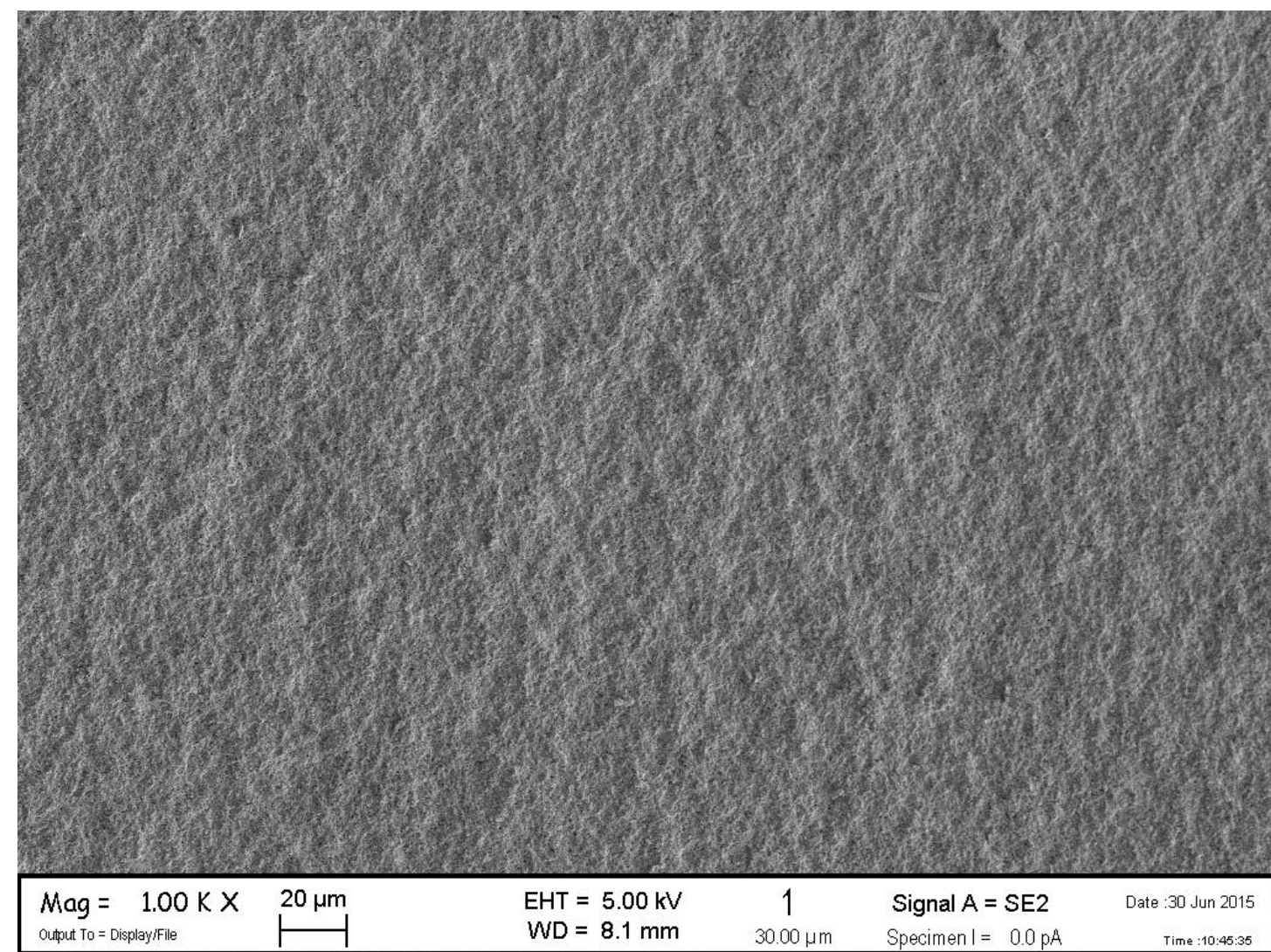
Microstructure

Ba_{0.75}Sr_{0.25}Fe₁₂O₁₉ powder
calcined at 900°Cx 6 h
sintered at 1200°Cx1min



$$\rho_{\%} = 90 \%$$

Ba_{0.75}Sr_{0.25}Fe₁₂O₁₉ powder
calcined at 900°Cx 6 h
milled for 10 h
sintered at 1200°Cx1min



$$\rho_{\%} = 94 \%$$

Conclusion

Pure M-type hexaferrite was produced by conventional ceramic process.

The quite dense microstructures don't shown abnormal grains and the fine microstructures are characterized by a grain size distribution lower than 2 μm.

The milling treatment allows to avoid macropores and get a slightly finer microstructure