

## Ball Milling of LAGP Powder Using MSK-SFM-12M-A

### Procedures

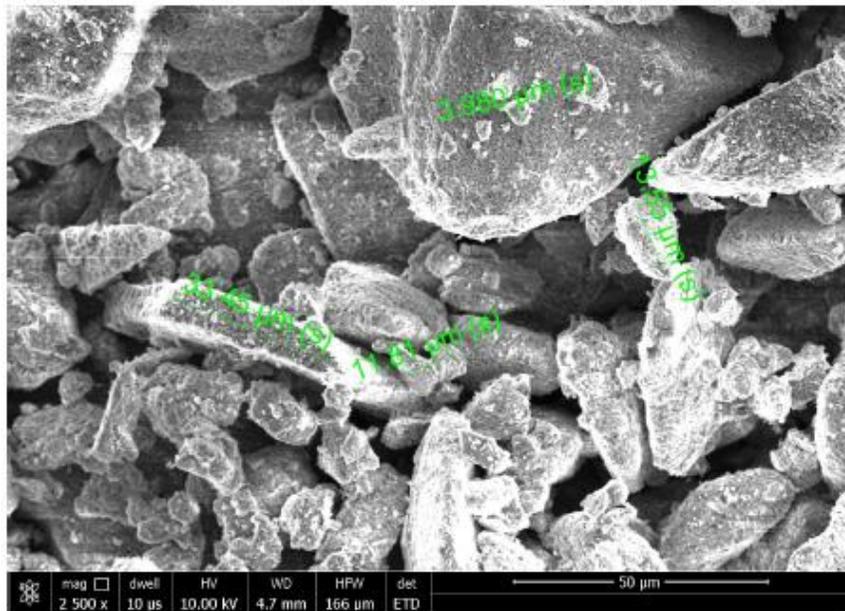
1. Mix  $\varnothing$  0.2 mm and  $\varnothing$  0.1 mm zirconia beads in a 1:1 ratio, and fill the 2.0 mL tube to  $\sim$ 1/3 of its volume.
2. Put LAGP (Li<sub>1.5</sub>Al<sub>0.5</sub>Ge<sub>1.5</sub>P<sub>3</sub>O<sub>12</sub>) powder (EQ-Lib-LAGP) into the 2.0 mL tube, and fill another  $\sim$ 1/3 of its volume. Limit the combined volume of powder and beads to be no more than 2/3 volume of the 2.0 mL tube.
3. Place the tube in the ball mill sample holder. Put in the counter weight in a symmetrical pattern. Configure the vibration speed and milling time. Start ball milling.
4. After the target milling time has reached, retrieve the milled powder for SEM imaging and powder size measurement.
5. Repeat the experiment with increasing milling time as shown in the table below.

### Results

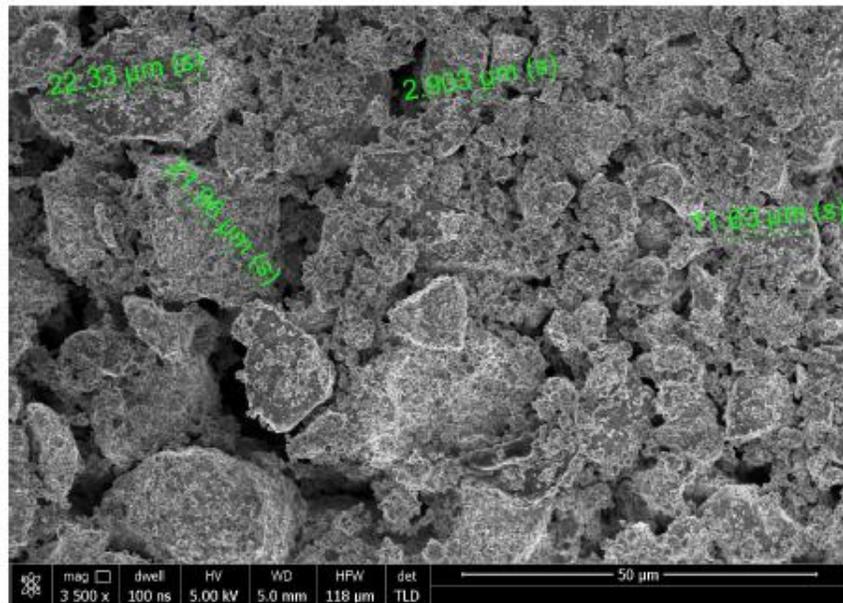
- Ball milling settings and the resulted powder size reduction.

No.	Vibration Speed (rpm)	Milling Time (min)	Avg. Size after Milling ( $\mu$ m)
0	0	0	15
1	4000	15	0.8
2	4000	30	0.5
3	4000	60	0.5

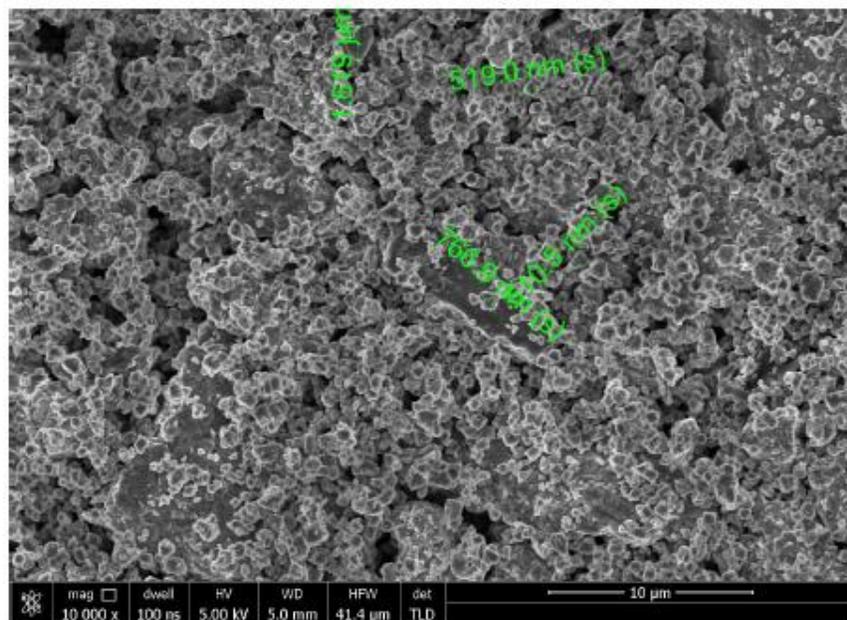
- SEM image of LAGP powder as received (Experiment No. 0).



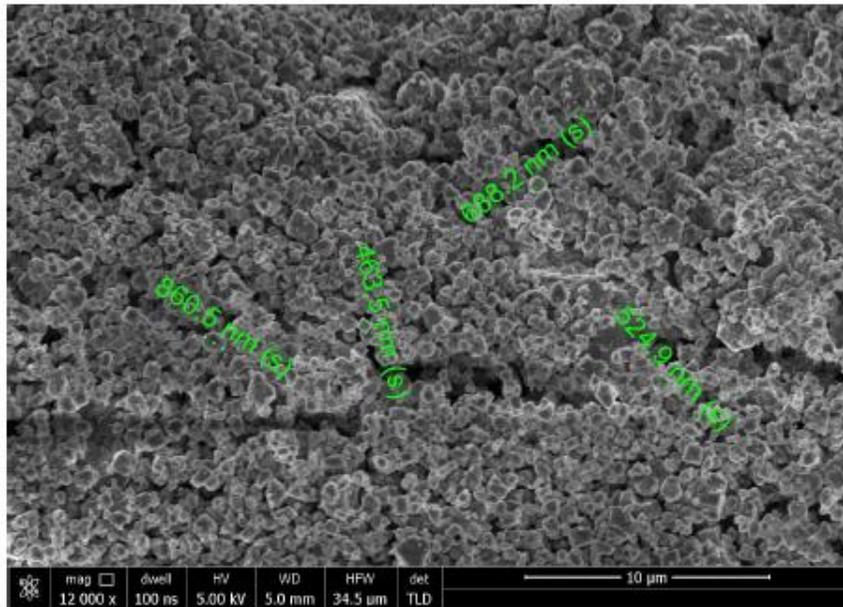
- SEM image of LAGP powder after 15 min ball milling (Experiment No. 1).



- SEM image of LAGP powder after 30 min ball milling (Experiment No. 2).



- SEM image of LAGP powder after 60 min ball milling (Experiment No. 3).



## Conclusions

Under the maximum vibration speed – 4000 rpm:

- With increasing milling time from 0 - 30 min, LAGP powder size is reduced from 15  $\mu\text{m}$  as received to 0.5  $\mu\text{m}$  with 30 min milling. Good power size uniformity is achieved after 30 min ball milling.
- There is no obvious change in power size with further increased milling time (30 – 60 min). To reduce the LAGP powder to even smaller sizes, user is recommended to experiment with the milling beads ratio / size.

## Experimental Materials and Equipments

### LAGP



LAGP (Li<sub>1.5</sub>Al<sub>0.5</sub>Ge<sub>1.5</sub>P<sub>3</sub>O<sub>12</sub>) Conductive Ceramic Powder, 100g/bag - EQ-Lib-LAGP

### Ball Mill



Micro-Vibration Mill with Zirconia Beads and 3" Agate Mortar - MSK-SFM-12M-A