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Particle Size Characterization of Ferritic Oxide Dispersion Strengthened Alloy Powders

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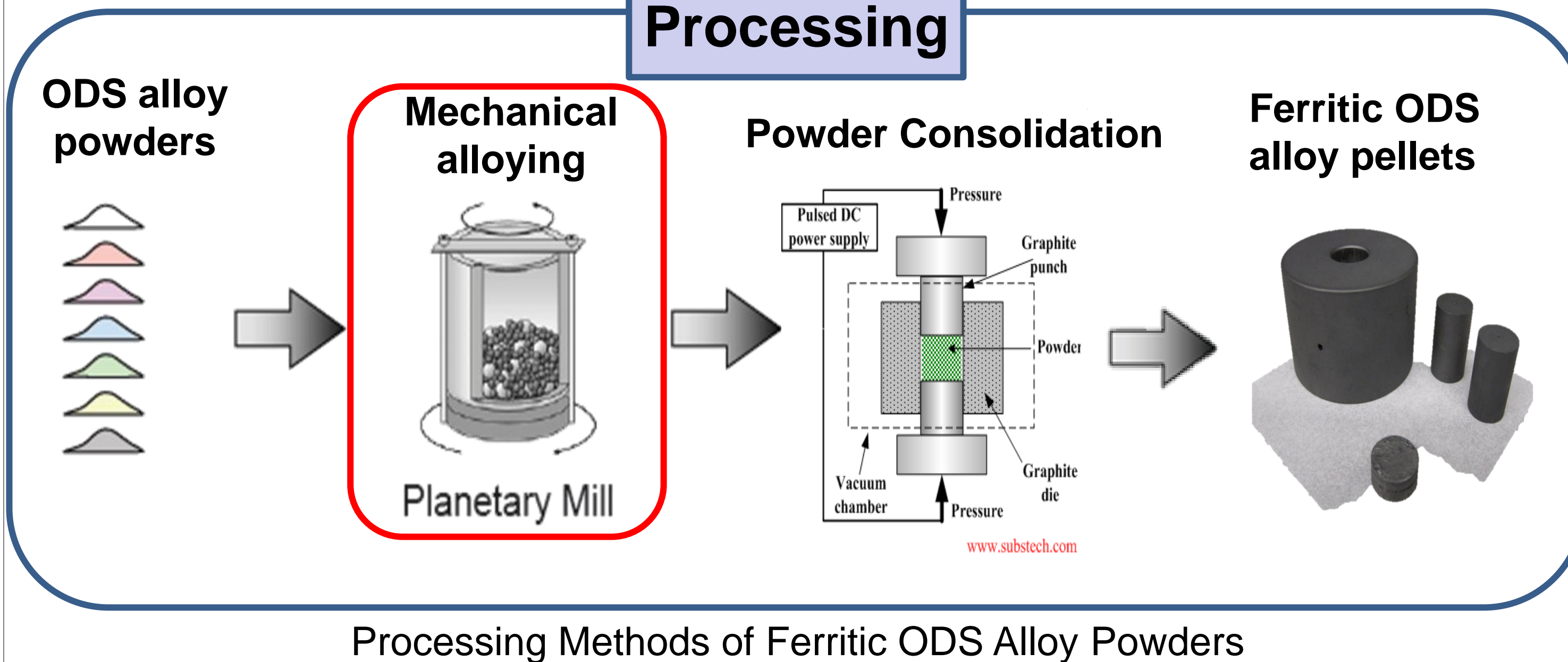
Introduction

Ferritic oxide dispersion strengthened (ODS) alloys are attractive candidates for applications in the high temperature industries due to their:

- superior elevated temperature strength,
- creep resistance, and
- irradiation resistance.

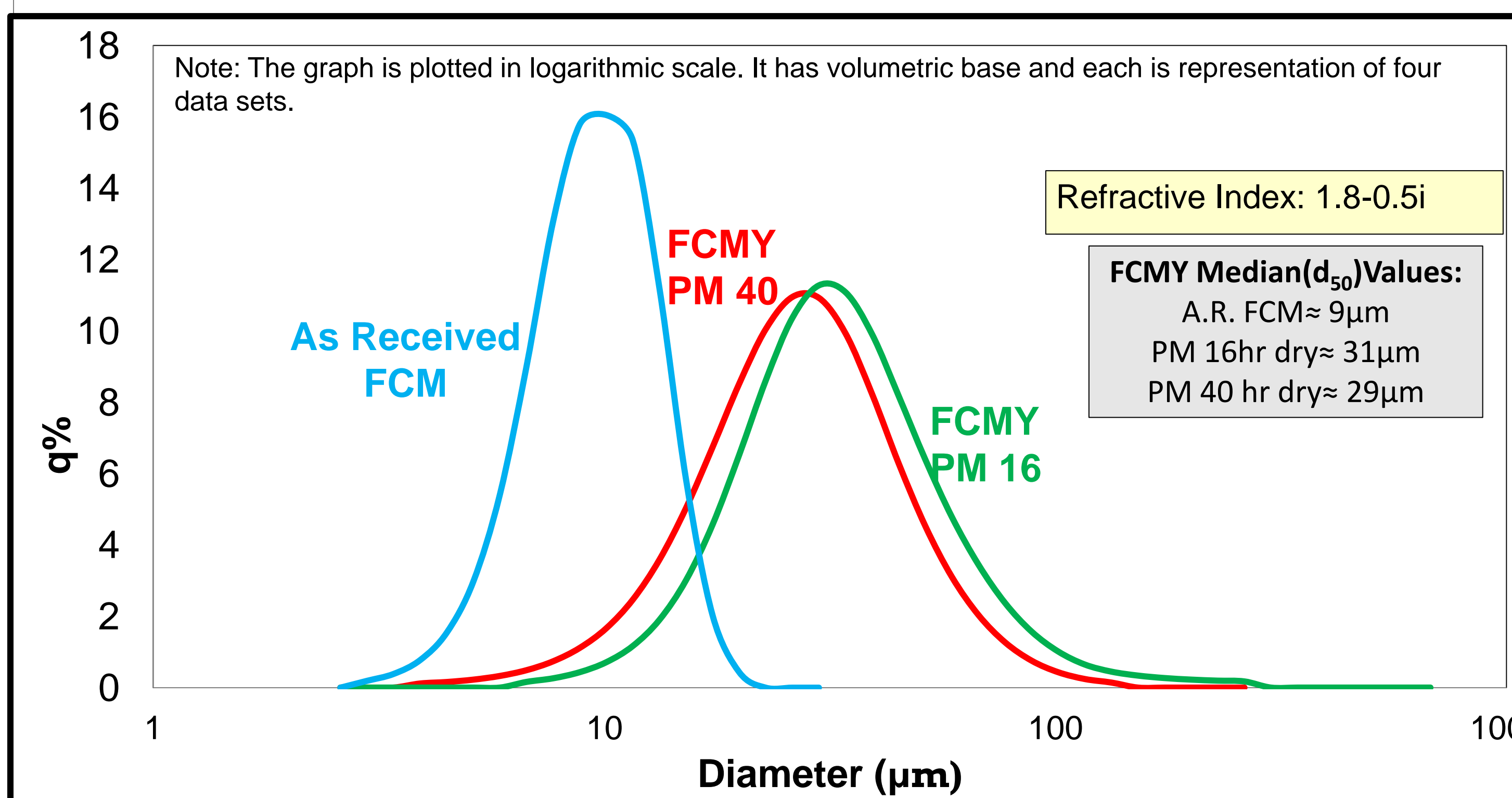
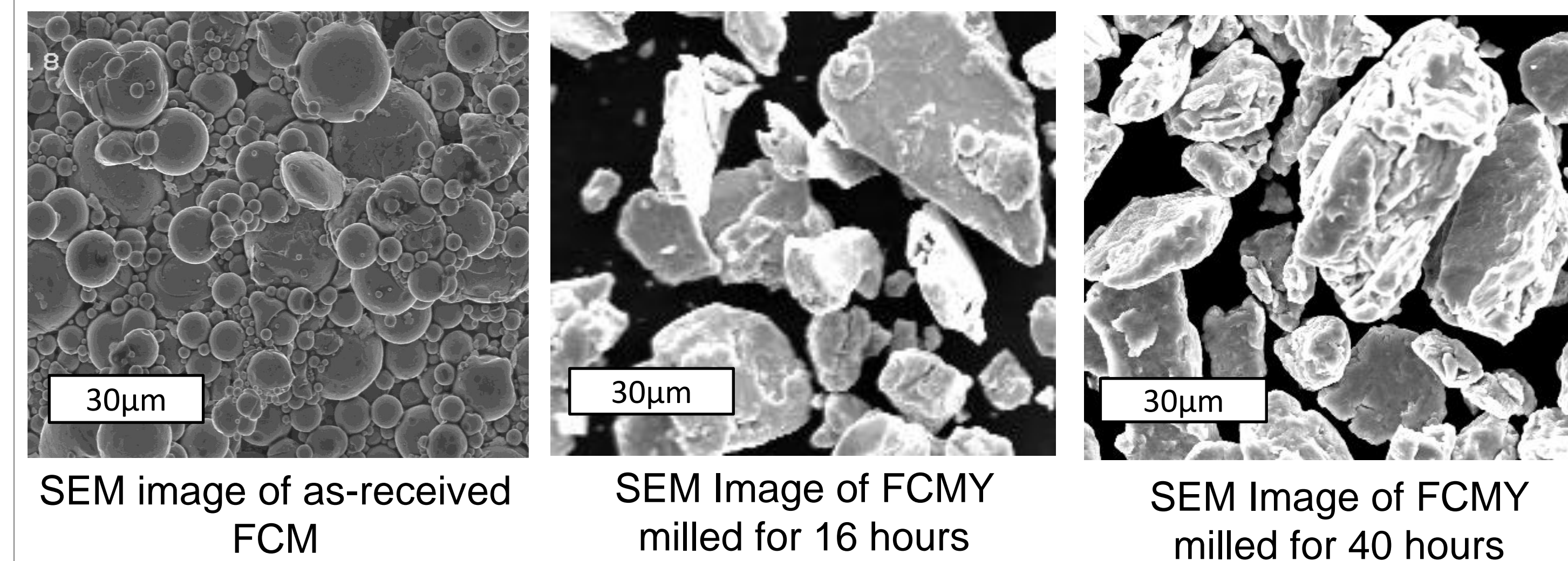
The dispersed oxide combine with other elements to form nano-meter sized features which are stable up to very high temperature. These features are important to the microstructure because they impede dislocation motion [1]. In this study, the effects of ball milling on the particle size distribution of two ferritic alloys was characterized to gain insight into sintering mechanisms during consolidation. The processing steps of the alloys are shown in the figure below.

Processing



Results

Particle Size Characterization- $Fe_{81}Cr_{16}Mo_3$ Alloy

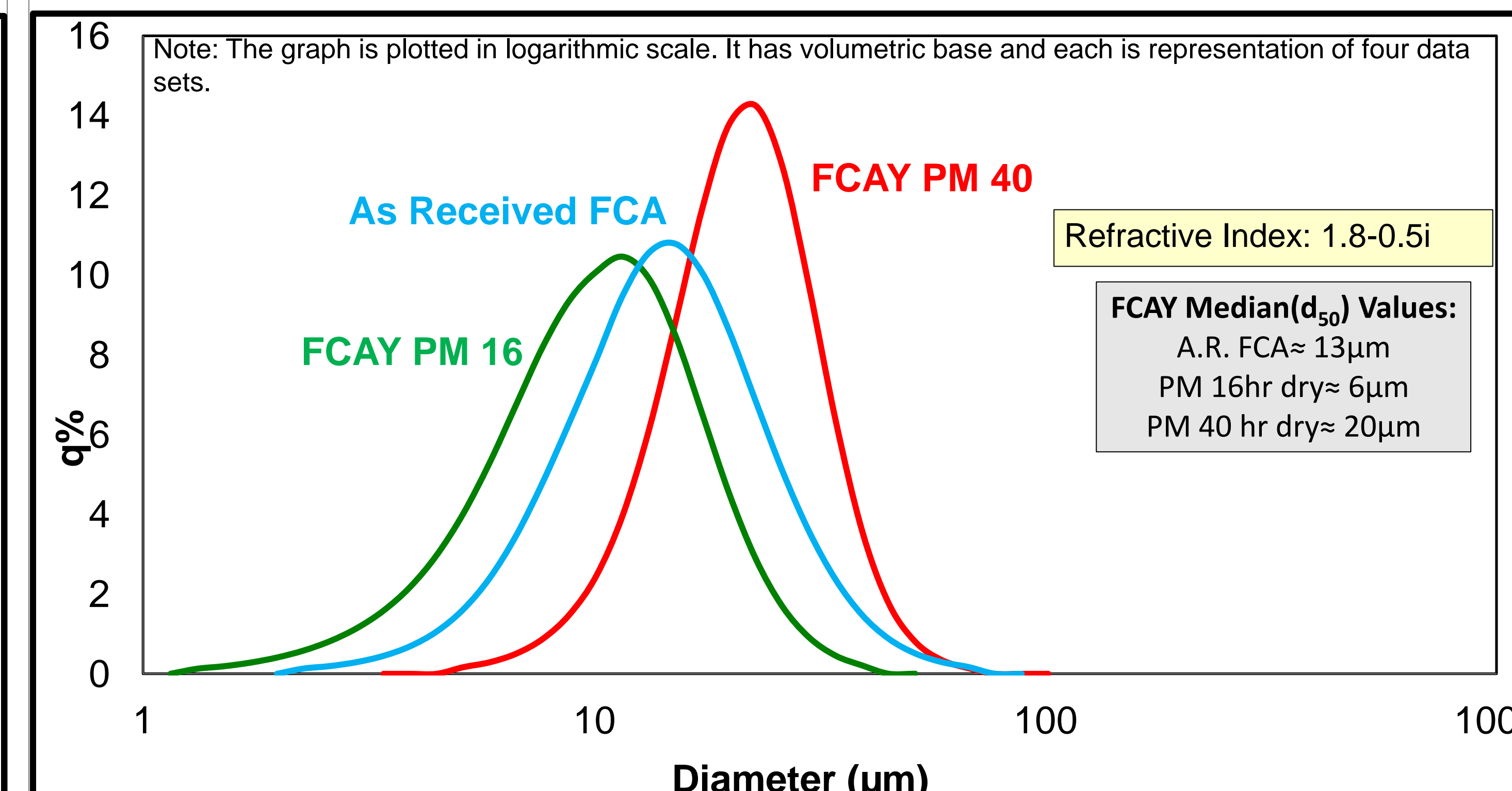
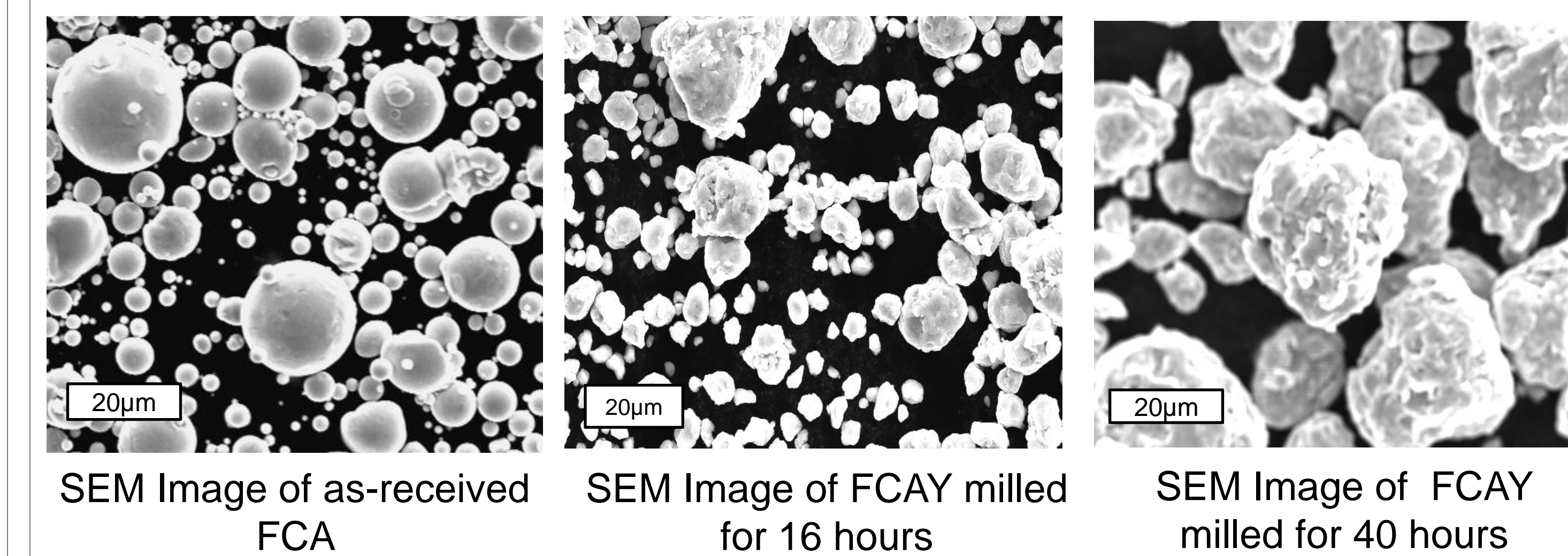


Particle size distribution of as-received FCM, FCMY milled for 16 hours and FCMY milled for 40 hours

FCMY	As Received	16 Hour Milling	40 Hour Milling
Median values	9 μ m	31 μ m	29 μ m

Results

Particle Size Characterization- $Fe_{81}Cr_{16}Al_3$ Alloy



Particle size distribution of as-received FCA, FCAY milled for 16 hours and FCAY milled for 40 hours

FCAY	As Received	16 Hour Milling	40 Hour Milling
Median values	13 μ m	6 μ m	20 μ m

Experimental Methods

$Fe_{81}Cr_{16}Mo_3$ with 0.5 wt% Y_2O_3 (FCMY) and $Fe_{81}Cr_{16}Al_3$ with 0.5 wt% Y_2O_3 (FCAY) alloys were separately milled in a Retsch Planetary Ball Mill PM100 at 500 RPM for 16 hours and 40 hours. The particle size characterization of FCMY and FCAY was completed using following techniques:

- Scanning electron microscope (SEM).
- LA-950 Horiba laser scattering particle size analyzer (PSA).



The steps for particle size characterization of FCMY and FCAY using LA-950 laser scattering PSA wet method are:

- Set the parameters for measurement:
 - Refractive Index: 1.8-0.5i
- Fill LA-950 with DI water.
- Activate circulation and agitation.
- Depress alignment to get proper alignment.
- Depress Blank to take a background reading of the dispersant.
- Transfer 2-3 grams of sample to the funneling area.
- Take measurement when distribution is stable.



Conclusions

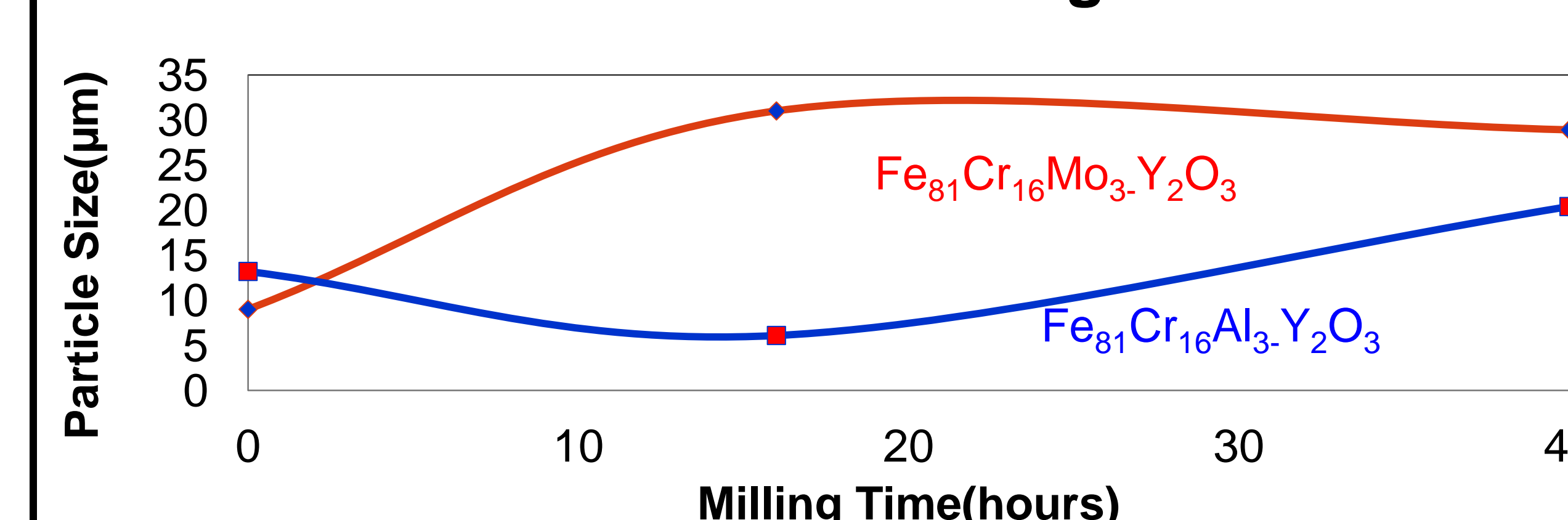
FCMY

The median particle size increased with milling. The increase in particle size is presumably from cold welding.

FCAY

The median particle size decreased after 16 hours of milling. This decrease is due to breaking of particles into smaller pieces from the impact of milling media. The median particle size increased after 40 hours of milling time. The increase in particle size is presumably from cold welding.

Particle Size vs. Milling Time



References

- [1]. Yingli Xu, Zhangjian Zhou, Ming Li, Pei He, "Fabrication and characterization of ODS austenitic steels," *Journal of Nuclear Materials* (2010)

Acknowledgements

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- Joshua Winger and Kyle Knori