

## Effect of Process Control Agent on a Mechanically Milled Pure Aluminum sample

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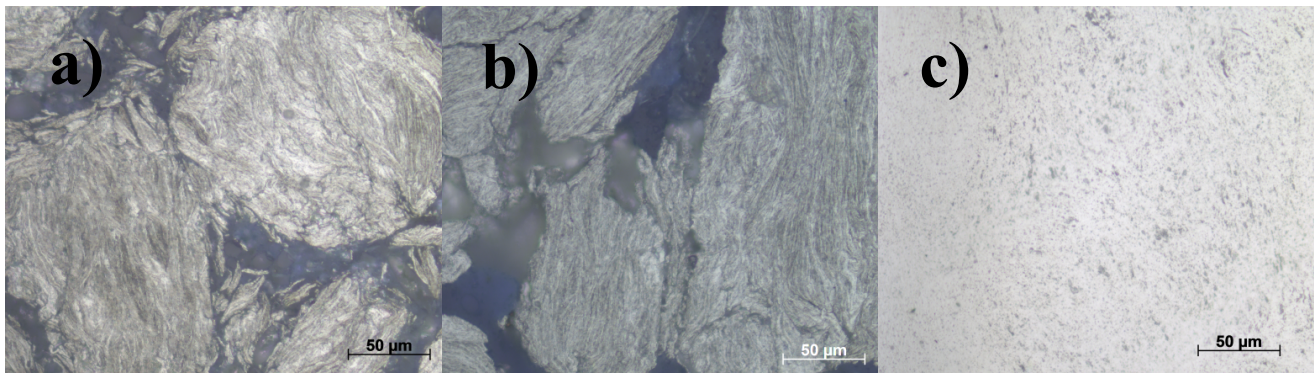
Aluminum (Al) has been used in many cases due to its reasonable mechanical properties [1]. Metal Matrix Composites (MMCs) have generally been prepared with a low-density metal such as Al and reinforced with ceramic particles [2]. Al-MMCs are valuable alternatives because of the fact, that addition of small amounts of reinforcements particles in the metallic matrix, offers an important increase on the mechanical properties. Using mechanical milling (MM) we can avoid the clustering of reinforcement particles in the Al structure [1]. The process control agent (PCA) is a surface additive used in the milling process to control the balance between the fracturing and cold welding of particles inhibiting the agglomeration and controlling the particle size. A wide range of PCA's has been used in practice at a level of about 1–5 wt.% of the total charge [3].

Pure Al powder (99.99% purity) was used as raw material. It was processed in a SPEX high-energy ball mill at room temperature for 2 h mill with a stainless steel and 13 mm balls, the ball to powder ratio (in wt.) was kept 5:1. As PCA, methanol was added to vial at the beginning of the process with ratios of 0, 1 and 2 mL [1]. The morphology of the powder particles was investigated through optical microscopy.

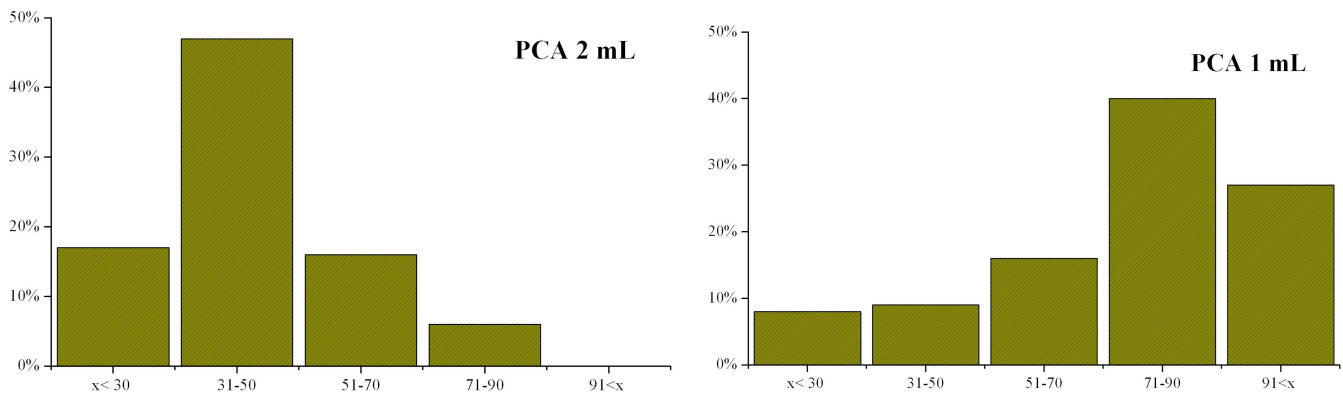
The Fig. 1 shows a typical lamellar microstructure related with ductile systems, as a direct effect of PCA addition, the Fig. 1a shows smaller particle sizes and a coarser sheets compared to the sample with less PCA (Fig. 1b). The sample processed without PCA generated a giant rounded particle with an extremely coarse lamellar microstructure as can see in the Fig. 1c. The histogram of the Fig. 2 shows that PCA reduce the particle size of the sample and induces a Gaussian distribution.

### References

- [1] JM Mendoza-Duarte *et al*, Science Direct **643** (2015), p. 172.
- [2] M Lee *et al*, Science Direct **204** (2017), p. 100.
- [3] A Canakci, T Varol, S Ozsahin, Science Direct **46** (2013), p. 1818.



**Figure 1.** OM micrographs of milled Al with a) PCA: 2 mL, b) PCA: 1 mL and c) PCA: 0 mL. (500X)



**Figure 2.** Particle size distribution graphs of samples with two PCA ratios (in μm).