Aluminum powder metallurgy (PM) alloys are under intense study as candidate materials for a growing number of automotive applications. Those based on the Al-Cu-Mg system are of particular importance given that they are responsive to PM processing yet they can also be heat treated to manipulate mechanical properties and the balance therein. Such modifications arise due to an array of precipitation strengthening mechanisms that can transpire during heat treatment. Common commercial heat treatments for Al-Cu-Mg alloys include T1, T4, and T6 tempers. The aluminum alloy studied was Al-2.3 Cu-1.5 Mg-0.5 Sn which is part of the 2000 series. Mechanical testing of the alloy focused on tensile and fatigue testing.

Conventional press-and-sinter PM processing was used to produce laboratory specimens:
1. Powder Mixing
2. Die Compaction
3. Sintering
4. Heat treatment

Results and Discussion

Tensile testing determined that the three heat treatments had different impacts on the tensile properties of the alloy. Yield strength, ultimate tensile strength, and ductility are shown below.

Fatigue strength was also affected by the three heat treatments. The fatigue properties varied according to a pattern comparable to that noted with ductility. The three-point bend fatigue results are shown below.

Optical microstructures for the three heat treatments are shown below.

There differences in the microstructures are subtle, but evident. Some precipitates (dark grey) can be seen, while others are too small to be clearly defined.

Conclusions

Through various testing methods, the properties of Al-2.3 Cu-1.5 Mg-0.5 Sn once subjected to different tempers was determined. T1, T4, and T6 heat treatments were used, and the results were as follows:
- Yield strength was affected by heat treatment. The T6 samples had the highest YS.
- Ductility was significantly reduced when a T6 treatment was used. The T4 samples displayed the highest tensile ductility.
- Fatigue strength varied in a similar fashion as ductility, with the T4 treatment displaying the highest strength (σ50%).

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