We Claim:

1. An Al-Sc composite comprising from 1.0 at% to 65 at% scandium (Sc) and from 35 at% to 99 at% aluminum (Al), having a microstructure including a first aluminum matrix phase and a second phase dispersed therethrough, the second phase comprising a compound corresponding to the formula $Al_xSc_y$, where x is from 0 to 3 and y is from 1 to 2; wherein the second phase further comprises from 1.0 mol% to 70 mol% scandium nitride (ScN), based on the total moles of the second phase.

2. The composite of claim 1, wherein the second phase comprises $ScAl_3$, $ScAl_2$, ScAl, $Sc_2Al$, or Sc, or combinations thereof.

3. The composite of claim 1, wherein the second phase comprises less than 60 mol% $Al_2Sc$, based on the total moles of the second phase.

4. The composite of claim 1, wherein the second phase comprises $ScAl_2$, ScAl, $Sc_2Al$, or Sc, or combinations thereof.

5. The composite of claim 1, wherein the microstructure includes from 5 vol% to 99 vol% of the first aluminum matrix phase and from 1% to 80 vol% of the second phase as determined by quantitative image analysis.

6. The composite of claim 1, wherein the concentration of scandium in the second phase is greater than the concentration predicted by the equilibrium phase diagram for aluminum-scandium.

7. The composite of claim 1, wherein the concentration of scandium in the second phase is at least 1% greater than the concentration predicted by the equilibrium phase diagram for aluminum-scandium.

8. The composite of claim 1, wherein the second phase comprises greater than 25 at% scandium.

9. The composite of claim 1, wherein the second phase comprises greater than 1 mol% of $Al_2Sc$, AlSc, $Al\ Sc_2$, or Sc or combinations thereof, based on the total moles of the second phase.

10. The composite of claim 1, wherein the second phase comprises less than 85 mol% aluminum, based on the total moles of the second phase.

11. The composite of claim 1, wherein grains of the first aluminum matrix phase are characterized by a crystallographic orientation of (110).

12. The composite of claim 1, wherein grains of the first aluminum matrix phase are characterized by a random crystallographic orientation.

13. The composite of claim 1, wherein the second phase is characterized as having a particle size ranging from 0.5 microns to 500 microns measured in accordance with ASTM E112.

14. The composite of claim 1, wherein the microstructure is substantially devoid of microcracks and fissures and/or oxide inclusions.

15. The composite of claim 1, wherein the composite further comprises less than 1000 ppm of oxygen, preferably less than 400 ppm, or more preferably less than 100 ppm.

16. A process for producing a non-equilibrium composite, the process comprising:

providing a second phase powder comprising a compound corresponding to the formula $Al_xSc_y$, where x is from 0 to 3 and y is from 1 to 2; wherein the second phase further comprises from 1.0 mol% to 70 mol% scandium nitride (ScN), based on the total moles of the second phase;

mixing the powder with a first aluminum matrix phase comprising aluminum to form a composite precursor;

applying at least one of heat or pressure to the composite precursor to consolidate the

materials and

cooling the consolidated composite precursor to form the non-equilibrium composite at a rate of greater than 1 ºC/min.

17. The process of claim 16, wherein the compound comprises $Al_2Sc$, AlSc, $AlSc_2$, or Sc, or combinations thereof, present in an amount greater than 1 mol%, based on the total moles of the second phase.

18. An Al-Sc composite sputtering target comprising from 1.0 at% to 65 at% scandium (Sc) and from 35 at% to 99 at% aluminum (Al), having a microstructure including a first aluminum matrix phase and a second phase dispersed therethrough, the second phase comprising a compound corresponding to the formula $Al_xSc_y$, where x is from 0 to 3 and y is from 1 to 2; wherein the second phase further comprises from 1.0 mol% to 70 mol% scandium nitride (ScN), based on the total moles of the second phase.

19. The sputtering target of claim 18, wherein the uniformity of scandium across a surface of the sputtering target varies by less than +/- 0.5 at% scandium over an entire radius of the surface.

20. The composite of claim 1 comprising at least 20 vol% of the first aluminum matrix phase.